

# Adopting the Euro: a Synthetic Control Approach\*

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## Abstract

We investigate whether joining the European Monetary Union and losing the ability to set monetary policy affected the economic growth of Eurozone countries. We use the synthetic control approach to create a counterfactual scenario for how each Eurozone country would have evolved without adopting the euro. We let this matching algorithm determine which combination of other developed economies best resembles the pre-euro path of twelve Eurozone economies. Our estimates suggest that most countries' economic growth was not significantly affected. There were some mild losers (France, Germany, Italy, and Portugal) and a clear winner (Ireland). The drivers of these economic gains and losses are heterogeneous. First, we find that Ireland's economic gains are more modest when excluding profits and income earned by foreigners. Second, our results show that adopting the euro spurred government consumption and trade and deterred private consumption and investment, on average.

**JEL classification:** E30, E60, C32, E02, E52, E65

**Keywords:** Monetary union; Eurozone; Synthetic control method; GDP decomposition; Macroeconomic performance

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“For all the seven long years since the signing of the Maastricht treaty started Europe on the road to that unified currency, critics have warned that the plan was an invitation to disaster.”  
Krugman (1998)

## 1 Introduction

In January 1999, the exchange rates between member countries’ national currencies and the euro were fixed irrevocably and the European Central Bank (ECB) officially took over the responsibility of conducting the unified monetary policy. Twenty-five years have passed since the euro was launched and the member states gave up their monetary policy independence. A single currency could have potentially boosted economic growth by eliminating exchange rate risks, facilitating flows of goods, people, and capital, and promoting competition and economic integration of the member states. In this work, we evaluate whether joining the euro had any macroeconomic effect for twelve of the Eurozone countries and investigate which were the channels driving it.

To address this question, we develop a counterfactual scenario that represents how each Eurozone country would have evolved without adopting the euro as their currency. For this analysis, we employ what is arguably the most important innovation in the policy evaluation literature in the last fifteen years - the synthetic control method (SCM) (Athey and Imbens 2017). We let this matching algorithm determine which combination of other OECD advanced economies best resembles the pre-euro path of each Eurozone member. We then compare the post-euro macroeconomic performance of each economy to its synthetic doppelganger. In particular, by decomposing the countries’ and the doppelgangers’ gross domestic product (GDP) into their components, we identify the main drivers of the accession gains and losses.

In the context of the Eurozone, it was expected that adopting a common currency would reduce the exchange rate volatility, the transaction costs, and any price discrimination (De Grauwe 2020). Most likely, it would spur trade and investment within the Eurozone (Frankel and Rose 1998). Notwithstanding, since its announcement, many have been calling into question the suc-

cess of the euro (Wyplosz 2006). They believed that the Eurozone did not satisfy the requirements of an Optimum Currency Area, especially due to the lack of labor mobility (Jonung et al. 2009). Additionally, the Eurozone countries could no longer set monetary policy independently thus becoming more exposed to external (asymmetric) shocks. Nowadays, the rising strength of nationalism movements in Europe has intensified doubts about the advantages of the Eurozone (Fligstein et al. 2012; Guiso et al. 2019). Some of the arguments put forward are the loss of sovereignty and the suitability of the “one-size-fits-all” monetary policy.

Our contribution is two-fold. First, we evaluate the macroeconomic impact of adopting the euro measured by the real GDP. Theoretical predictions about this effect are ambiguous and depend on whether the costs outweigh the benefits of joining the Eurozone.<sup>1</sup> Indeed, we find that there are some mild losers (France, Germany, Italy, and Portugal) and a clear winner (Ireland). Such heterogeneous findings are in line with previous work on the topic (De Grauwe 2020; Puzzello and Gomis-Porqueras 2018).

Most notably, we perform a GDP decomposition exercise to investigate which channels drove the output gains and losses and whether they differed from country to country. For Ireland, private consumption and investment notably explain almost 80% of the total output gain from joining the euro. While for France and Portugal, private consumption and net exports accounted for a large share of the economic loss, in the case of Germany and Italy, private consumption and investment explain the negative impact of the euro. For most countries, the trade volume was significantly higher than if they had not joined the Eurozone. Nonetheless, the common currency had a strong positive impact on the trade balance solely for Luxembourg.

**Literature Review.** This paper is related to several strands of the literature. The first one is directly related to the methodology used to construct the counterfactuals. To employ the SCM, we follow the original work by Abadie and Gardeazabal (2003) and Abadie et al. (2010, 2015) who developed the methodology.<sup>2</sup> Furthermore, we follow more recent work by Campos et al.

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<sup>1</sup>We refer the reader to Lane (2006) and Beetsma and Giuliodori (2010) who provide a more recent account of the real effects of the European Monetary Union by surveying the literature on its macroeconomic costs and benefits.

<sup>2</sup>A good overview of the literature using this methodology can be found in Abadie (2021).

(2019) who evaluate the impact of the European Union accession, Born et al. (2021) who assess the macroeconomic impact of the election of Donald Trump as the President of the USA, and finally Breinlich et al. (2020) and Born et al. (2019) who study the costs of economic nationalism by looking at the Brexit vote impact on the transactions and GDP, respectively.

The second strand of the literature relates to the political economy of monetary unions. We build on work by Eichengreen and Frieden (1993); Feldstein (1997); Dyson and Featherstone (1999); Willett (2000); James (2012); and Spolaore (2013) who find that countries adopted the euro because of political rather than economic motivations, to rule out reverse causality and study the macroeconomic impact of joining the euro.

This paper also contributes to the literature that studies the macroeconomic impact of joining a currency union. Starting from the groundbreaking contribution of Mundell (1961) on the theory of optimal currency areas, many economists have been studying the key characteristics that allow a group of countries to benefit from having the same currency. McKinnon (1963) and Kenen (1969) have added seminal contributions to this theory by exploring the role of international trade and diversified output structures in determining the costs and benefits of joining a monetary union.

More recent work from Alesina and Barro (2002) explains that forgoing monetary policy, on the one hand, implies losing a stabilization device to deal with domestic shocks but, on the other hand, can boost credibility and price stability. Alesina and Barro (2002) show that if there is a reduction in trading costs, the adoption of a common currency has a direct positive effect on trade, output, and consumption.<sup>3</sup>

There is also a broad literature that empirically tests these theoretical links. At about the time the euro was launched, Rose (2000) famously estimated that a currency union could boost up to three times bilateral trade. The relevance of these results to the euro case was immediately doubted since the sample used for the analysis was based on unions of small, poor, and remote countries. Micco et al. (2003) developed the first comprehensive study for the impact of the European Monetary Union (EMU) on trade, concluding that the euro had a positive impact not only

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<sup>3</sup>Alesina et al. (2002) and Barro and Tenreyro (2007) empirically investigate and present evidence of these theoretical predictions.

on trade between member states but also with third parties. Some papers have also highlighted the impact of currency unions on investment. Among others, Barr et al. (2003) suggest that inward investment in the countries outside the union would have been greater if they had joined the EMU. Furthermore, De Sousa and Lochard (2011) estimate that, in the Eurozone countries, investment increased with the single currency adoption.

Finally, this paper closely relates to the recent literature about the euro adoption using the synthetic control approach (Fernández and Garcia-Perea 2015; Verstegen et al. 2017; Gasparotti and Kullas 2019) but makes three important contributions. First, we build directly on the work of Puzzello and Gomis-Porqueras (2018) by extending their analysis from six to the twelve member states that joined the Eurozone before 2007. This contributes to a comprehensive picture of the macroeconomic effects of the euro accession.

Second, this paper further adds to the existing literature by unpacking the results of the economic gains and losses of the euro accession. In particular, our results show that, for the majority of Eurozone countries, adopting the euro deterred investment and private consumption, but spurred trade and government consumption. Moreover, there seems to be a negative link between fiscal spending before and after the euro adoption. Most countries in the sample implemented spending-based austerity measures after the Maastricht Treaty (Alesina et al. 2019). This has likely created fiscal space which together with access to cheaper credit promoted an increase in government consumption beyond what would have happened absent the euro adoption.

Third, this paper adds the drivers of Ireland’s large economic gains following the euro adoption. When extending the baseline analysis to the Gross National Income (GNI), Ireland’s economic gains from the euro adoption, though still positive, become more modest and reduced by more than two-thirds. This means that the large Irish economic gains measured by GDP are closely related to the activities of these multinational corporations that contribute significantly more to GDP—through the production and services rendered within the country—than to GNI, as a large portion of their profits are repatriated to foreign investors or parent companies abroad.

The remainder of this paper is organized as follows. Section 2 describes the construction

of the doppelganger, its implementation, and the data used. Section 3 presents the results and robustness exercises. Section 4 explores the potential channels through which the euro adoption affected the GDP. We briefly conclude in Section 6.

## 2 Constructing the Doppelganger

### 2.1 The Synthetic Control Method

To measure the impact of the EMU accession on the macroeconomic performance of the Eurozone countries, we construct a doppelganger for each Eurozone country based on the synthetic control methodology (SCM) developed by Abadie and Gardeazabal (2003) and Abadie et al. (2010, 2015).<sup>4</sup> Ideally, these doppelgangers behave just like the Eurozone economies except for the euro adoption.

The goal is to compute the treatment effect of a policy intervention:

$$\tau_{i,t} \equiv Y_{i,t}^I - Y_{i,t}^C$$

where  $Y_{i,t}^I$  represents the realized outcome of country  $i$  in period  $t$  and  $Y_{i,t}^C$  stands for the non-observable outcome of country  $i$  in period  $t$  absent from the policy intervention. Abadie and Gardeazabal (2003) proposed the SCM to estimate  $Y_{i,t}^C$  by constructing a doppelganger as a weighted average of the outcomes of non-treated units. We refer to these units as “donor countries” and to the set of these countries as “donor pool” throughout the paper. Suppose that we have  $N + 1$  countries and country  $i = 1$  is exposed to the intervention of interest. Then, an unbiased estimate of the treatment effect, which we refer to as doppelganger gap throughout this paper, is defined as:

$$\hat{\tau}_{1,t} = Y_{1,t}^I - \sum_{i=2}^{N+1} w_i Y_{i,t} \tag{1}$$

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<sup>4</sup>A detailed exposition of the method can be found in Abadie (2021).

where  $w_i$  is the estimated weight assigned to donor country  $i$  to construct the doppelganger.

The weights are chosen to minimize the difference between each treated unit and its doppelganger's pre-intervention outcome variable and predictors.

Aiming to study the macroeconomic impact of the euro accession, we use real GDP as the main outcome variable of this analysis. First, real GDP is one of the most important metrics to assess countries' degree of real convergence and economic growth. Second, it allows us to unpack the baseline result by studying how each GDP component changed after the euro accession. Following Born et al. (2019, 2021), we normalize real GDP to unity in the first sample year, 1970.<sup>5</sup>

Moreover, the set of predictors used is based on Abadie and Gardeazabal (2003) and Born et al. (2021). These predictors are the average GDP shares of private consumption, government consumption, investment, exports, imports, the employed share of the population, the labor productivity growth, the inflation rate, the real GDP and its lags.<sup>6</sup>

Formally, let  $\mathbf{x}_1$  denote the  $(37 \times 1)$  vector of 30 observations for real GDP (including its 29 lags) and 8 covariates' averages in each Eurozone country (over the pre-treatment period) and let  $\mathbf{X}_0$  denote a  $(38 \times 14)$  matrix with observations from the donor countries. Finally, let  $\mathbf{w}$  denote a  $(14 \times 1)$  vector of weights  $w_i$ ,  $i = 2, \dots, 15$ . Then, the optimal weighting scheme is defined by  $\mathbf{w}^*$  which minimizes the following mean squared error:

$$(\mathbf{x}_1 - \mathbf{X}_0 \mathbf{w})' \mathbf{V} (\mathbf{x}_1 - \mathbf{X}_0 \mathbf{w}) \quad (2)$$

subject to:

$$w_i \geq 0 \text{ for } i = 2, \dots, 15 \quad (3)$$

$$\sum_{i=2}^{15} w_i = 1 \quad (4)$$

where  $\mathbf{V}$  is a  $(14 \times 14)$  symmetric and positive semidefinite weighting matrix assigning different relevance to the characteristics in  $\mathbf{x}_1$  and  $\mathbf{X}_0$ . Following Abadie and Gardeazabal (2003)

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<sup>5</sup>Focusing on the normalized per capita real GDP instead does not qualitatively change the results (Figure A.1).

<sup>6</sup>We avoid the so-called cherry-picking problem in Ferman et al. (2020) by choosing a standard set of predictors based on previous empirical literature.

and Abadie et al. (2010), we choose a diagonal  $V$  matrix such that the mean squared prediction error of the outcome variable (and the covariates) is minimized for the pre-treatment period.<sup>7</sup>

### 2.1.1 Implementation

The SCM offers several advantages to study the question at hand. This method is transparent regarding the construction of the counterfactual and the fit of the control unit to the treated unit. It provides the exact weight of each donor country for the construction of the doppelganger. The fit of the counterfactual can be inspected by comparing the outcome variable and other characteristics of the treated unit with the estimated data. It is also important to highlight that this method allows the design decisions, like the choice of donor pool and predictors, to be made regardless of post-treatment considerations and without knowing the implication for the results. Moreover, the SCM precludes extrapolation since the estimated weights are non-negative and sum to one (King and Zeng 2006).

To successfully implement the SCM several contextual and data requirements should be satisfied (Abadie 2021). Especially for estimating causal effects, the credibility of the results severely depends on whether these requirements are met in the empirical application at hand. Therefore, we now present these requirements and how we address them.

First, treated units and the donor countries should be comparable. The counterfactual should be identical to the treated unit in all dimensions except for the treatment assignment. When the treated unit is a country, an “ideal” control unit rarely exists in observed data because countries differ widely across demographic, legislative, and economic characteristics (Born et al. 2019). Yet, the donor pool selection should try to accommodate this need.

It is important to restrict the donor pool to units with outcomes that are expected to be driven by the same structural processes as the treated unit (Abadie et al. 2015). When using developing countries with structurally higher growth rates to create a doppelganger for an advanced econ-

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<sup>7</sup>Including the covariates in the optimization differs from Kaul et al. (2022) who have raised concerns about including all pre-intervention outcomes together with covariates when using the SCM. The covariates used are relevant for the computation of the doppelgangers and its choice hinged on theoretical grounds.

omy with structurally more modest growth rates, results are condemned to be biased. Using a smaller donor pool that guarantees more similarities with the treated unit should be preferred, albeit the expected poorer fit (Abadie and Gardeazabal 2003). Unlike Puzello and Gomis-Portuerras (2018) and Gasparotti and Kullas (2019), we ensure that the donor countries can resemble the level of economic and social development of the treated units by using only OECD economies in our estimates.

Secondly, since the counterfactual weights are constructed according to the pre-intervention characteristics, we have to ensure that there are no (external) differentiated shocks during the study period in the donor pool countries (Abadie 2021). To account for this, we only consider observations until 2007. From 2008 onward, the great financial recession and the European sovereign debt crisis affected countries in very different ways and might have caused structural changes in the affected economies. While before the great recession, there were no major differences in average economic growth, after 2008 treated units grew on average much slower than the donor pool countries.

It is also important to exclude any country that was treated from the donor pool. In this context, this is addressed by using only donor countries that never adopted the Euro. Yet, Denmark, Sweden, and the UK, which belonged to the European Union (EU) but did not adopt the Euro, are included in the donor sample. One important consideration is that, even though the euro adoption and the EU accession are intertwined, the cumulative gains of entering the EU stopped before 1999 for Denmark and the UK and are insignificant for Sweden (Campos et al. 2019).

Furthermore, policy interventions frequently have spillover effects on non-treated units. When employing the SCM, it is important to ensure that the counterfactuals are not affected by the treatment. In our analysis, this is equivalent to ruling out the possibility that the euro adoption by an individual country affected the outcome variable of the donor countries. This assumption is tested by performing in-space placebo tests in section 3.2.2.

Fourth, the intervention does not affect the outcome before the implementation period. In section 3.2.1, potential anticipation effects are tested by changing the treatment date used in the

analysis.

Fifth, the SCM requires a sizable number of pre- and post-intervention periods. In the literature, previous SCM applications with yearly data use between 20 (Abadie and Gardeazabal 2003) and 30 pre-treatment periods (Abadie et al. 2015). The reason is that the credibility of a synthetic control depends upon how well it tracks the treated unit’s characteristics and outcomes over an extended period of time prior to the treatment. The post-treatment period should be long enough to account for delayed or dissipated effects of the intervention. These requirements are satisfied with the data used in the analysis as discussed next in section 2.2.

Finally, it is important to guarantee that there are no extreme values in the variable of interest for the treated units. The SCM is based on the idea that a combination of unaffected units can approximate the pre-intervention characteristics of the affected unit. However, if the treated unit exhibits “extreme” values for the outcome variable this is not possible. We address this issue by normalizing real GDP (Born et al. 2019).

## 2.2 Data and Sample

We use annual data from 1970 until 2007 from the the World Bank and the Penn World Tables, version 9.1 (Feenstra et al. 2015). We focus on the real GDP as our main outcome variable and conduct our analysis on twelve Eurozone countries, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.<sup>8</sup>

We assume the treatment date takes place in 1999 for all countries except for Greece, which joined the Eurozone later in 2001. In our baseline estimate, we have at least 29 pre-intervention periods, from 1970 to 1998, which is sufficiently large to apply the SCM.

Doppelgangers are constructed on the basis of a donor pool of 14 countries selected as follows. First, only OECD countries are used to ensure that doppelgangers are sufficiently similar to the treated countries. Then, all countries that joined the European Union or the Eurozone during the post-treatment period are excluded. This guarantees that the donor countries are neither affected

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<sup>8</sup>Consult Table A.1 for further details on the data.

by the treatment nor suffer a differentiated external shock during the post-treatment period.

For our baseline estimates, we do not restrict the donor pool further except for countries for which the necessary data is not available. The pool is composed of Australia, Canada, Chile, Denmark, Iceland, Israel, Korea, Mexico, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

We believe this donor pool is just narrow enough to guarantee that these donor countries are comparable to the treated units but do not compromise the application of the SCM and estimation of the counterfactuals. Possible flukes to this belief are assessed in section 3.3 where we perform robustness checks by excluding individual and groups of countries from the donor pool.

### **3 Empirical Results**

This section starts by presenting the baseline results for the impact of the euro accession. Next, taking into account the assumptions addressed in Section 2.1.1, we discuss the statistical significance and causality of these results by performing two types of placebo exercises. First, in Section 3.2.1, we perform in-time placebo tests in which placebo treatment dates are assigned to the treated countries. Second, we apply in-space placebo tests in Section 3.2.2 which assign the treatment to all countries in the donor pool. Finally, we discuss the statistical significance of our results and provide an extensive list of robustness checks. The main findings in this section corroborate the results of Puzzello and Gomis-Porqueras (2018) and add new insights by concluding that the results for France, Germany, Ireland, Italy, and Portugal are statistically significant.

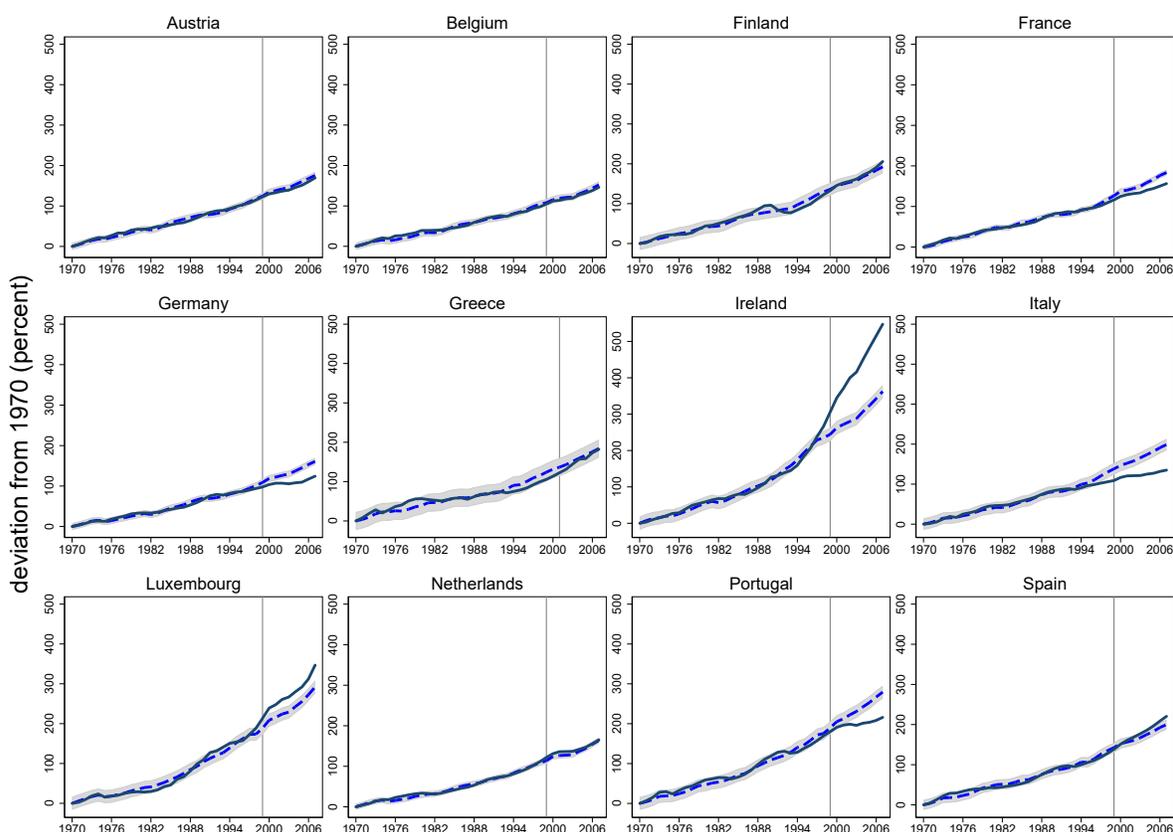
#### **3.1 Baseline Results: Assessing Euro's Macroeconomic Impact**

It is expected that the SCM yields an imperfect pre-treatment match for some countries given that our procedure determines 14 parameters (country weights) to match 37 observations. Notwithstanding, this methodology can provide substantial improvement relative to alternative methods as differences-in-differences (Ferman and Pinto 2021), and thus, we are confident that

this data-driven approach is the best to study the problem at hand.

Figure 1 displays the real GDP for each country (full black line) and doppelganger (dashed blue line) presented as the deviation from the first year of the sample in percent. The shaded area represents two standard deviations of the pre-treatment difference between the actual and the counterfactual series. When the doppelganger series deviates from the realized path in such a way that exceeds these bounds, it indicates that such deviation is non-standard compared to the pre-euro period.

Figure 1: The Impact of the Eurozone Accession



Notes: In each graph, the dashed line represents the normalized real GDP for the synthetic country and the continuous line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession. The vertical line represents the treatment period - 1999 for all countries except for Greece which is 2001. For each country, the analysis starts in 1970 and ends in 2007.

A number of observations stand out. The pre-treatment paths for most countries and their

doppelgangers are overlapping. Moreover, Figure 1 shows some series embarking on a different growth trajectory relative to their counterfactuals only around the Eurozone creation.

Table 1 presents the exact doppelganger gaps measured in euro per capita. According to our estimates, Ireland benefited the most from the euro adoption. Its GDP per capita was €10,961 higher due to the common currency adoption. However, France, Germany, Italy, and Portugal would be better off by not participating in this currency union. Yet, Germany and Italy lost the most: €4,864 and €7,351 per capita respectively.

Table 1: Doppelganger Output Gap

	AUT	BEL	FIN	FRA	DEU	GRC	IRL	ITA	LUX	NLD	PRT	ESP
<b>Gap</b> (€ per capita)	-682	-679	1,269	-2,843	-4,864	-153	10,961	-7,351	5,157	168	-3,706	1,539

Notes: This table presents the doppelganger output gap per capita in 2007. This measure is obtained by adjusting the real GDP gap for the population size and converting 2011 US dollars into 2011 euro. We use the conversion rate available from the PWT 9.1 for this year ( $\approx 0.73$ ).

Table A.2 shows that doppelgangers are very similar to the actual countries when comparing their predictors means despite using the same specification for all countries.<sup>9</sup> Furthermore, in Appendix B, we show that the doppelgangers are successful in recovering the time path of all GDP components for most of the analyzed countries.

Table A.3 displays the donor country weights that constitute each doppelganger. For instance, the synthetic Ireland is composed by all countries in the donor pool, and yet it is significantly constructed by using data from the Norway (51%), Chile (29%), Israel (15%), and Korea (4%). We are overall confident about the plausibility and credibility of the methodology weighting scheme.<sup>10</sup>

## 3.2 Causality

A key assumption to study the impact of a policy intervention is that there is no reverse causality. In our context, this means that countries must not have adopted the euro due to eco-

<sup>9</sup>Matching only the key variable might suffice but having further similarities in related variables is also important and ensures the robustness of the findings Botosaru and Ferman (2019).

<sup>10</sup>Potential concerns regarding the use of countries that belong to the Exchange Rate Mechanism (Denmark, Sweden, and the United Kingdom) are addressed in Section 3.3.

conomic considerations. This assumption is plausible because the Eurozone accession was driven mainly by political rather than economic factors (Feldstein 1997; Dyson and Featherstone 1999; Willett 2000; Spolaore 2013).<sup>11</sup> The adoption of the euro was seen more as a political project aimed at deepening European integration; reducing the risks of conflict; and creating a stronger Europe on the global affairs (Eichengreen and Frieden 1993; James 2012).

The case for economic considerations driving the euro adoption is more unclear. Feldstein (1997) found that the economic impact of joining the EMU would be uncertain, with the possibility of some small gains in trade and investment, accompanied by larger unemployment and inflation. Fernández-Villaverde et al. (2013) studies the mechanisms through which the adoption of the euro delayed, rather than advanced, economic reforms in some Eurozone countries.

Moreover, the euro area is not considered an optimal currency area (OCA), which casts doubt on the strength of the economic motivations behind its adoption. According to (Mundell 1961), OCA have labor mobility, capital mobility, a risk-sharing system such as a fiscal transfer mechanism, and similar business cycles among the member countries. Labor mobility was limited by language and cultural barriers, and there was significant divergence in economic conditions and fiscal policies among the member states. Importantly, by not satisfying the requirements of an Optimum Currency Area, many economists believed that some countries adopting the euro would face economic losses (Jonung et al. 2009).

Even though there are expected gains in terms of real economic growth from adopting a fixed exchange regime, that is not expected for all countries alike – Arvai and Gabriel (2023) provide evidence that countries with less credible monetary policy are the ones growing disproportionately more after pegging their currency to a more credible anchor.

Sections 2.1.1 and 2.2 discussed the conditions under which the SCM provides suitable estimates of causal effects and this section addresses some of these requirements. To further back the notion that the doppelganger gap is indeed caused by the euro adoption, Sections 3.2.1 and 3.2.2

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<sup>11</sup>This argument holds even for the Greek case which had decided to join the euro before the single currency was a reality. According to the 1998 convergence report from the European Commission, Greece did not join the single currency in 1999 because it had not fulfilled any of the four convergence criteria. Notwithstanding, the decision to join was already made.

provide two key placebo experiments. We can be confident that the synthetic control estimator captures the causal effect of an intervention as long as similar magnitudes are not estimated in cases where the intervention did not take place (Born et al. 2019). Finally, Section 3.2.3 discusses the statistical significance of the results.

### 3.2.1 In-Time Placebo Test: Anticipation Effects

On 7 February 1992, representatives from twelve countries signed the Maastricht Treaty – Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom. Upon signing it, it was common knowledge that a monetary union, with a central banking system and a common currency, was to be created within the next years. It is, therefore, reasonable to think that countries experienced, at least partly, the Eurozone accession’s impact before the euro was launched.

To check for anticipation effects of the euro adoption, we perform in-time placebo tests by inspecting different intervention periods in our analysis. The date the Maastricht Treaty was signed is taken as the placebo treatment period. Figure 2 suggests that the qualitative conclusions from Figure 1 remain unchanged.

We ran further time-placebo tests in which the placebo treatment date is set artificially to be every year from 1992 until 1998. For the sake of brevity, besides the Maastricht Treaty date 1992, we only report the tests for 1995 in Figure A.2. Reassuringly, the results remain unaltered.

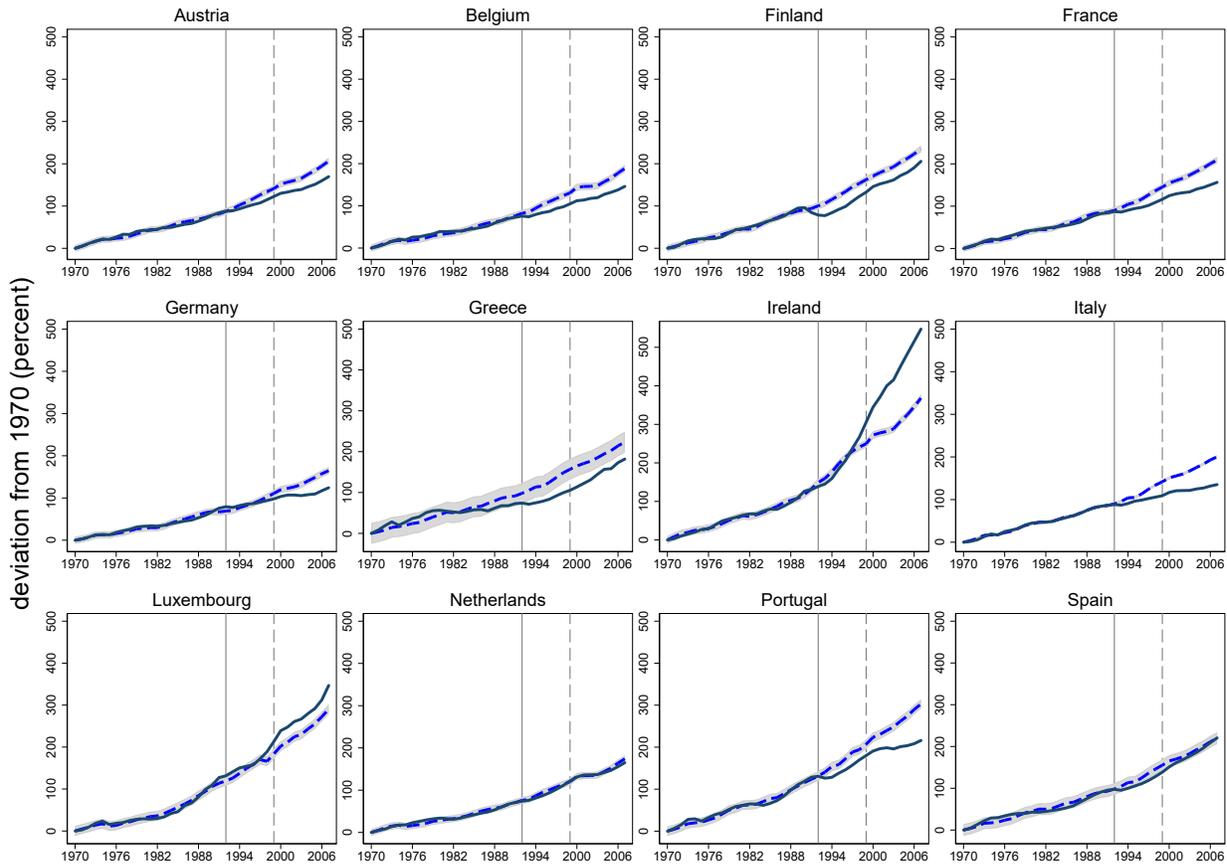
Figure 2 presents limited evidence in favor of the existence of anticipation effects. If anything, the gap between the actual and the synthetic series becomes wider than the one analyzed in Figure 1. Notwithstanding, the direction of the effect remains unchanged. Thus, ignoring possible anticipation effects in our baseline estimates may lead to a lower bound of the euro impact for countries like Austria, Belgium, France, and Italy.<sup>12</sup>

Moreover, some countries experienced important events between the Maastricht Treaty and the Euro Accession which likely affected economic growth. First, Italy dropped from the exchange

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<sup>12</sup>The case for Greece is not worrisome given its bad pre-treatment fit and, therefore, its lack of significance.

Figure 2: In-time Placebo Tests



Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession. The vertical line depicts the placebo treatment period - 1992 for all countries. For all countries, the analysis starts in 1970 and ends in 2007.

rate agreement to a floating regime in 1993. Second, Austria and Finland joined the EU only later in 1995, thus the in-time placebo might be picking up effects from the EU accession. Third, several countries adopted spending-based consolidation measures in the period following the Maastricht Treaty, which might have caused contractionary effects (Gabriel et al. 2023) and the “premature” widening of the gap.

The absence of anticipation effects for the remaining countries may be due to two things. First, the key event representing a change for most European citizens was the irrevocable exchange rate fix on 31st December 1998 and the euro launch on the 1st of January 1999. Second, most of these

countries had already experienced trade and economic gains from joining the European Union (Campos et al. 2019). Therefore, such effects lie in our pre-treatment sample and thus, are already being considered.

### 3.2.2 In-Space Placebo Test

Following Abadie et al. (2010), Abadie and Cattaneo (2018), and Firpo and Possebom (2018), we employ the synthetic control methodology on the donor pool countries while exposing them to a placebo treatment in 1999. The idea is to sequentially “re-assign” the treatment to all units in the donor pool and, for each of them, estimate a fictitious doppelganger using the remaining donor countries and the originally treated unit. We repeat this process for every treated country.

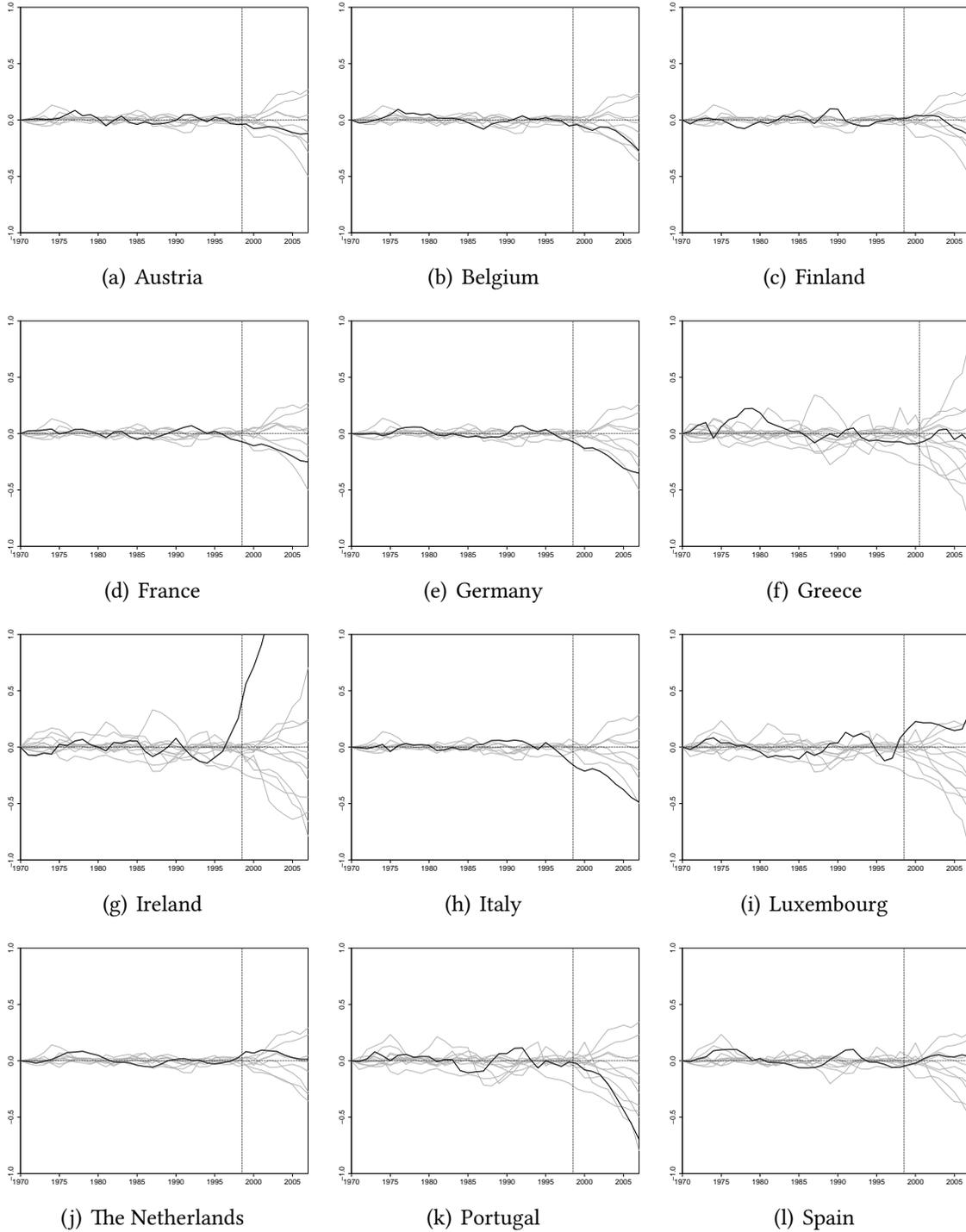
Next, we compare the post and pre-treatment behavior of these series and inspect the differences between treated and fictionally treated units. If our benchmark estimates for each Eurozone country are picking up the causal effect of the euro accession, these should dominate any possible impact of the fictitious event in the donor countries. On the other hand, if no difference is found, then most likely the actual intervention had no effect. Applying this idea to each country in the donor pool allows us to compare the estimated effect of the euro accession on Eurozone countries to the distribution of placebo effects obtained for the other countries (Abadie et al. 2015).

The plots from Figure 3 depict the doppelganger gaps for treated countries (black lines) and donor countries (grey lines), that is, the differences between each country’s normalized GDP and their doppelgangers’ estimates. The smaller the gap for the pre-treatment period, the better the fit of the synthetic series to the outcome variable. Donor countries with a bad pre-intervention fit are excluded from the in-space placebo test because they are not suited to inform about the post-treatment effect.<sup>13</sup> In the Appendix, Table A.4 presents the associated pre-treatment RMSPEs that speak to the good quality of the pre-treatment fit for the treated units, with values ranging between 0.03 and 0.09, closely in line with the donor pool pre-treatment RMSPEs. Notwithstanding, given the heterogeneity of the RMSPEs, we will take that into account when discussing inference

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<sup>13</sup>We define a good pre-intervention fit following Firpo and Possebom (2018) when the pre-intervention MSPE of a donor country is at most four times greater than the Eurozone country’s pre-intervention MSPE being analyzed.

Figure 3: In-Space Placebo Tests



Notes: The plotted lines represent the prediction error for the treated country (black) and donor countries (grey) for which we impose a fictitious euro accession. We do not plot the donor countries whose pre-treatment MSPE was four times larger than the one of the treated country.

in Section 3.2.3.

Visually, Figure 3 reinforces the findings in Figure 1. When comparing the full black lines from each Eurozone country to the grey lines of fictitious treated units, it is clear that, for some countries, the post-treatment gap is unusually big. Specifically, it suggests a positive impact of the euro accession on Ireland and Luxembourg and a negative impact, if any, on France, Germany, Italy, and Portugal.

### 3.2.3 Statistical Significance

To evaluate the statistical significance of our estimates and following Abadie et al. (2010); Abadie and Cattaneo (2018), we use a test based on the classic framework for permutation inference which builds on the computations presented in the previous section.

Given our estimates of all fictional treatment effects in the previous section, we can evaluate the statistical significance by computing a p-value associated with the treatment. First, we compute the ratio of root mean squared prediction errors (RMSPE) in the post-intervention period relative to the pre-intervention period for treated and fictitiously treated units as follows:

$$\chi \equiv \frac{RMSPE_{post}}{RMSPE_{pre}} \equiv \frac{\sqrt{\frac{1}{T-T_0+1} \sum_{t=T_0}^T (x_{1,t} - \mathbf{x}_{0,t}\mathbf{w})^2}}{\sqrt{\frac{1}{T_0-1} \sum_{t=1}^{T_0-1} (x_{1,t} - \mathbf{x}_{0,t}\mathbf{w})^2}} \quad (5)$$

where  $x_{1,t}$  denotes the GDP of the treated country at period  $t$ ;  $\mathbf{x}_{0,t}$  denotes a vector of observations of GDP for the donor countries in period  $t$ ;  $\mathbf{w}$  denotes a vector of weights for the donor countries,  $T$  denotes the total number of periods, and  $T_0$  denotes the treatment date.

This statistic already allows a quantitative analysis of the treatment effect taking into account the quality of the match produced by the SCM. A small pre-treatment RMSPE implies a good fit of the synthetic series to the actual series and a large post-treatment RMSPE suggests, for the treated units, a large intervention impact. Therefore, obtaining a larger ratio for the treated unit than for the placebo-treated units would entail a significant treatment effect. A large post-intervention

RMSPE *per se* is thus not indicative of a large effect of the intervention. It depends on whether the synthetic control can reproduce closely the outcome of interest prior to the intervention (Abadie 2021).

Table 2 depicts this relative measure for the Eurozone countries (“Treated” column) and its donors. Ireland stands out as the country with the highest RMSPE ratio with a post-intervention gap about 15 times larger than its pre-intervention gap, followed by Italy, Portugal, Germany, and France.

Table 2: Relative RMSPE of the Pre- and Post-Treatment Doppelgänger gaps.

	AUS	CAN	CHL	DNK	ISL	ISR	KOR	MEX	NZL	NOR	SWE	CHE	GBR	USA	Treated	P-Value ( $\rho$ )
<i>AUT</i>	3.0	5.0	2.9	4.5	1.7	1.3	2.9	4.4	3.1	7.6	4.4	3.2	1.1	4.0	3.2	0.5
<i>BEL</i>	2.9	4.6	2.9	5.97	3.0	1.8	3.0	4.4	3.3	5.7	4.4	3.2	1.5	5.2	3.4	0.5
<i>FIN</i>	2.6	5.3	2.9	4.42	2.9	1.3	2.9	4.4	3.3	7.7	3.6	3.2	1.3	3.9	1.8	0.9
<i>FRA</i>	3.0	2.5	2.9	4.3	1.6	1.3	2.9	4.4	3.1	7.4	2.5	3.2	1.5	4.0	5.0	<b>0.13</b>
<i>DEU</i>	2.8	4.74	2.9	5.0	2.9	1.3	2.9	4.4	3.3	7.7	4.4	3.2	1.2	2.9	6.0	<b>0.13</b>
<i>GRC</i>	2.8	3.8	2.6	4.8	3.4	2.4	2.7	5.2	3.6	5.9	4.7	3.0	1.3	5.2	0.5	1.0
<i>IRL</i>	2.8	5.3	1.0	4.4	2.0	8.2	2.9	4.4	2.8	8.8	4.4	3.2	1.8	5.1	15.5	<b>0.07</b>
<i>ITA</i>	2.0	3.7	2.9	4.8	1.8	1.3	2.9	3.6	3.2	7.7	4.4	3.2	1.2	5.4	7.9	<b>0.07</b>
<i>LUX</i>	2.7	5.7	2.9	5.9	2.0	1.3	3.0	4.4	2.8	7.4	4.4	3.2	2.4	3.9	3.7	0.5
<i>NLD</i>	3.0	5.7	2.9	7.7	2.6	1.3	3.0	4.4	2.6	7.5	4.4	3.2	1.6	3.9	1.8	0.9
<i>PRT</i>	3.0	5.2	2.9	4.7	3.0	1.3	2.9	3.7	2.9	7.5	4.4	3.2	1.9	3.9	6.3	<b>0.13</b>
<i>ESP</i>	2.0	4.8	2.9	4.8	1.8	1.3	2.9	4.4	3.2	7.7	4.4	3.2	1.8	3.9	1.5	0.9

Notes: The column *Treated* displays the RMSPE ratio for each country,  $\chi$  in equation 5. The column *P-Value* displays the chances of obtaining a ratio as high as the treated country if one were to pick a country at random from the sample including also the treated country (equivalent to  $\rho$  in equation 6). Given the small number of donor countries, we consider the results sizeable if there is at most 1 country other than the treated country with a higher RMSPE ratio (p-value of 0.133). Table A.4 presents the estimates for the pre-treatment RMSPEs, the denominator of the values presented here.

We deem the effect of the euro adoption significant if the estimated effect for the treated units is unusually large relative to the distribution of the placebo effects - which is the case for Germany, France, Ireland, Italy, and Portugal. To test this in practice, we follow Abadie et al. (2015) and compute a p-value which compares the value of the RMSPE ratio for the treated country to that of all other units as follows:

$$\rho_1 = \sum_{i=1}^{N+1} I(\chi_i \geq \chi_1) / (N + 1) \quad (6)$$

where  $I(\cdot)$  denotes the indicator function,  $N$  the number of donor countries,  $\chi_1$  the RMSPE

ratio for the treated unit and  $\chi_i$  is the RMSPE ratio for country  $i$  which can be a donor or the treated country.

If one were to pick a country at random for the Irish case, the chances of obtaining a ratio as high as the Irish one would be 1 out of 15. The exact same interpretation holds for Italy. For Germany, France, and Portugal the chances of obtaining a ratio as high as their own would be 2 out of 15, the own country and Norway, which is deemed a sizeable effect.

### 3.3 Changes to Donor Pool

This section addresses two concerns. First, some countries in the control group may have opted out of the treatment. This would suggest a reverse causality problem and raise doubts about the credibility of the results presented. As discussed at the beginning of Section 3.2, countries used in the analysis must not have opted in or out due to economic considerations.

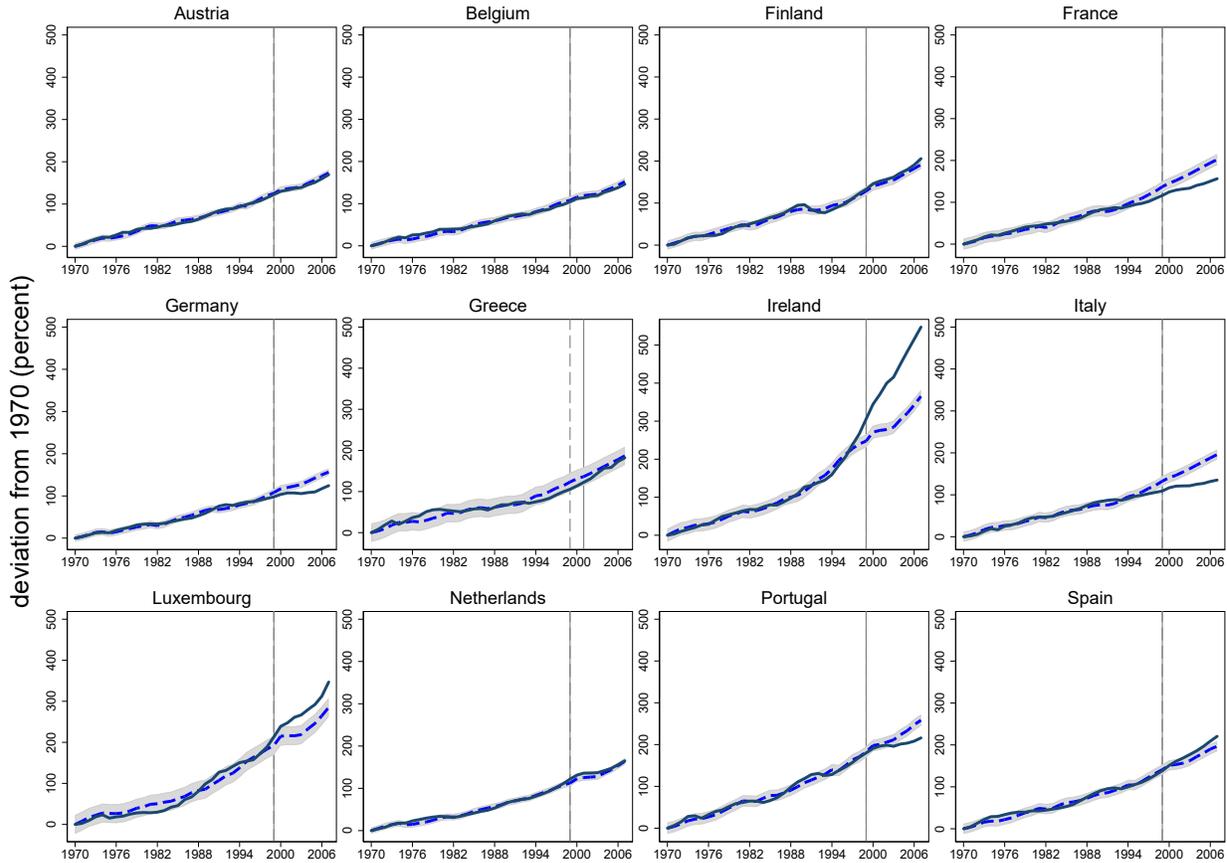
In fact, the UK, Sweden, and Denmark belonged to the European Union at the time but did not adopt the common currency. Even though they did opt out due to political reasons, we still address this issue by excluding these countries altogether from the donor pool.<sup>14</sup> We redo our analysis with this new pool and the results are presented in Figure 4. The main conclusions remain unchanged, in particular, for the ones whose doppelgangers' construction highly relied on this trio.

Second, there might have been spillover effects of the treatment on the donor countries. We address this issue by iteratively re-estimating our baseline estimate for each Eurozone country excluding in each iteration one of the countries with positive weight (Abadie et al. 2015). Moreover, this robustness check also tests the hypothesis that a single country in the donor pool biased the results. If the exclusion of a single unit from the donor pool has a large effect on results—without a discernible change in pre-intervention fit—the estimated results might be caused by other interventions or by particularly idiosyncratic shocks on the outcome of the excluded untreated unit.

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<sup>14</sup>Removing all European countries, or middle-income OECD countries like Mexico and Chile instead do not qualitatively change the robustness of the exercise.

Figure 4: Impact of the euro Accession with a Change in the Donor Pool



Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger prior to the euro accession. The vertical line depicts the treatment period - 2001 for Greece and 1999 for the remaining countries. For all countries the analysis starts in 1970 and ends in 2007. Relative to the baseline analysis, the donor pool now excludes Denmark, Sweden and the United Kingdom. Table B.5 show the weights used to construct these results.

We display this robustness check for countries that weighted, at least, 10% in the construction of, at least, 2 countries' counterfactuals in Appendix A.7. This exercise shows that no particular donor country is driving the main conclusions. So, it is unlikely that there were spillover effects of the treatment on the donors or that one specific country in the donor pool is driving the results. The robustness of SCM comes exactly from having similar results using different donors, even if the estimated weights change.

## 4 Unpacking the GDP gap

In this section, we take one step further and inspect the results presented in Figure 1 by decomposing the euro accession response of GDP into the response of its components. First, we compute the series for each GDP component for both countries and corresponding counterfactuals. Then, we uncover which components were positively or negatively affected and account for the output gains and losses from the accession.

This analysis begins by constructing the synthetic shares of GDP components using the weights estimated in Section 2 and the data from the donor countries. We use the weights previously computed to be able to directly decompose the GDP and also to avoid over-fitting when using this method.

Similarly to the construction of the synthetic GDP series, we now compute the synthetic shares of each GDP component as a weighted average of the shares of GDP components for the donor countries. To be precise, we thus obtain GDP shares of private consumption, investment, government consumption, exports, and imports. Then, we use each component share and the GDP series to compute the five GDP components series for both countries and doppelgangers. In Appendix B, we present these series as a deviation from the 1970 value in percent.

It is important to highlight that comparing the actual and the synthetic series from Appendix B also indicates whether the doppelganger can really mimic the behaviour of each country prior to the euro accession. We must recall that the construction of the doppelganger in Section 2 only targets the average and not the time path of GDP components and thus, a good fit in this regard can not be taken for granted. Overall, the figures from Appendix B reassure us of the good fit of our estimates with the majority of the series lying inside the two standard deviations band in the pre-treatment period.

Next, we compute the contribution of each GDP component for the output gap generated by the treatment. In section 2.1, Equation 1 defines the doppelganger gap as the difference in real GDP between the treated and the synthetic country. The cumulative treatment effect can be estimated by computing the doppelganger gap for  $t = 2007$ , the last year of our analysis.

Here, we proceed in four steps. Analogously to Equation 1, we start by computing doppelganger gaps for each GDP component. Then, we compute the relative weight of each component  $z$  on the output doppelganger gap in the following way:

$$\text{weight of } z_{c,t} = \frac{z_{c,t} - z_{c,t}^{dop}}{GDP_{c,t} - GDP_{c,t}^{dop}} \quad (7)$$

where  $z$  is either private consumption, government consumption, investment, exports, or imports, the subscript  $c$  stands for one of the twelve treated countries, and the subscript  $t$  represents the time period. Thereafter, we calculate the **percent** doppelganger gap for GDP as follows:

$$\text{percent output doppelganger gap}_{c,t} = \frac{GDP_{c,t} - GDP_{c,t}^{dop}}{GDP_{c,t}^{dop}} \quad (8)$$

Showing the treatment effect in percent terms allows a direct interpretation of how much larger/smaller the GDP is due to the euro accession. Finally, we multiply the relative weight of each doppelganger gap  $z_{c,t}$  by the percent output doppelganger gap. This allows us to understand the direct contribution of each channel to the treatment effect.

Figure 5 depicts, for each country, the percent GDP gap in 2007 and its decomposition. It clearly shows that countries experienced the euro accession heterogeneously.<sup>15</sup>

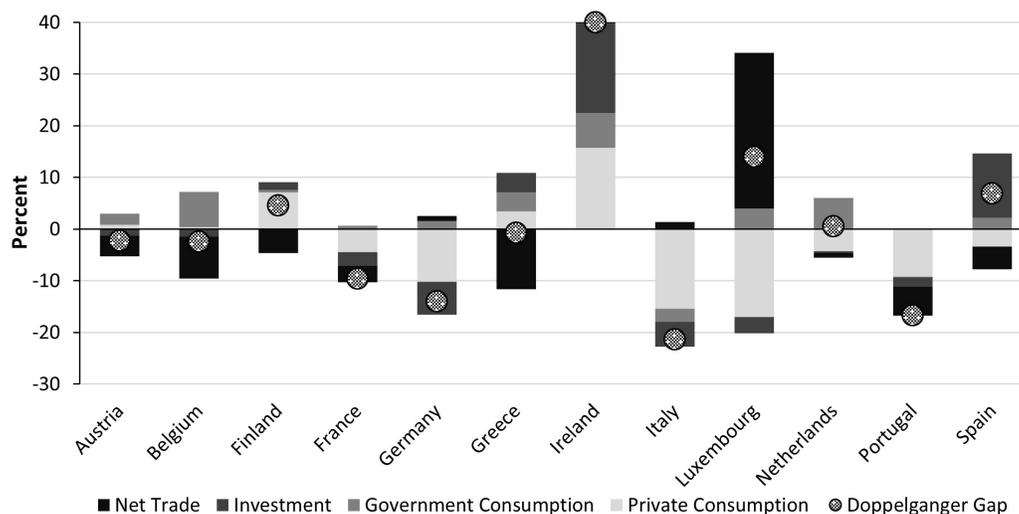
We now take a deeper look into the countries which were significantly affected as argued in Section 3.2. For Ireland, joining the Eurozone boosted GDP by 40%. Even though all GDP components contribute positively to this result, private consumption and investment together explain more than 80% of the total output gain from the treatment.

Figure 5 also shows that the reasons behind the economic slowdown experienced by some countries at the euro accession differ from country to country. We find that for France and Portugal, the private consumption and the net exports accounted for a large share of the GDP gap. For Germany and Italy, it is the private consumption alongside investment that better explains the negative economic impact of the euro adoption.

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<sup>15</sup>See Table B.6 for the exact values depicted in Figure 5.

Figure 5: Doppelganger Gaps and GDP Components



Notes: The dot depicts, for each country, the percent doppelganger gap of output computed as in Equation 8. The stacked bars represent the contribution of each GDP component for these gaps. The values for GDP component sum up the percent doppelganger gap for each treated unit. The values represent the cumulative effect of the euro accession since they are computed for 2007, the last year of the analysis.

For most countries, government consumption contributed positively to growth. This might seem a puzzling finding given that Eurozone countries were operating under the fiscal rules of the Stability and Growth Pact (SGP) during the post-treatment period.<sup>16</sup> However, before the euro accession, there were stringent Maastricht convergence criteria which might have restricted government consumption before the euro launch, possibly increasing fiscal space until 1999.

Most countries in the sample implemented spending-based austerity measures after the Maastricht Treaty (Alesina et al. 2019).<sup>17</sup> This has likely created fiscal space which together with access to cheaper credit promoted an increase in government consumption beyond what would have happened absent the euro adoption. The exceptions that see a reduction in government consumption following the euro adoption are Portugal and Italy, countries that adopted spending-based consolidation measures worth more than 3% of GDP between 2005 and 2007 (Alesina et al. 2019).

<sup>16</sup>Nevertheless, according to Bofinger (2003), the correlation between the average real growth rate of government consumption and fiscal deficits between 1999 and 2002 was negative, meaning that the low deficit rules did not necessarily imply less government spending.

<sup>17</sup>Countries that implemented spending-based austerity measures between 1992 and 1998 were Austria, Belgium, Germany, Spain, Finland, France, and Italy.

Before the Euro, the need to exchange local currencies implied extra transaction costs and exchange rate risk. The single currency was expected to boost cross-border trade and investment between the member states since doing business in the Eurozone would be more cost-efficient and less risky De Grauwe (2020). For third parties, the Eurozone would be an attractive place to invest as well. Consumers would benefit from price transparency and stability. Therefore, it would be expected an increase in investment, exports, and imports but it is not clear in which direction the trade balance would go.

Table B.7 reveals that most countries had a higher trade volume than if they had not adopted the common currency, in line with findings by Baldwin et al. (2008) and Schmitz and Von Hagen (2011). Yet, our estimates show that only a few countries experienced net trade benefits, aligning with the findings of Hope (2016)

Moreover, even though the common currency was expected to attract foreign investment for the whole Eurozone, Ireland stands out from the remaining member countries. Investment in Ireland increased significantly because of the euro adoption. Therefore, country-specific characteristics have significantly shaped the impact across member states.

## **5 Did Euro Area Nationals Gain with the Euro Adoption?**

GDP and GNI are both important measures to gauge the economic performance of a country. GDP measures the total value of all goods and services produced in a country, focusing on the output generated by the factors of production within the country, regardless of the nationality of the owners. GNI, on the other hand, measures the total income earned by a country's residents, regardless of where they are located geographically. It includes GDP plus any income earned from abroad by residents of the country, excluding income earned domestically by foreign residents.

Given that for some euro adopters like Ireland profits and income earned by foreign companies operating domestically play an important role, we extend the analysis to using GNI as an outcome variable. Due to data limitations, Greece and some donor countries are excluded from

this exercise, namely Switzerland and Iceland. Luxembourg's doppelganger cannot be estimated as it is the country with the highest GNI per capita.

Figure 6 shows the results. Ireland's economic gains from the euro adoption are still positive when measured by GNI, thus total income earned by residents increased amid the euro adoption. However, these gains are considerably smaller than when using GDP. To be precise, Ireland's estimated gap drops by approximately two-thirds (Table B.8). For other countries with statistically significant results, results remained broadly unchanged albeit with a poorer pre-treatment fit given not only the lower number of donor countries used in this analysis but also the targeted measure. France has a relatively stronger result for GNI, while the effect on Italy is mildly attenuated.

Ireland has become an attractive destination for high-growth companies and global corporations due to its favorable corporate tax environment, skilled workforce, the membership in the European Union, and, most importantly, in the Eurozone.<sup>18</sup> While the activities of these multinational corporations contribute significantly to Ireland's GDP through production and services rendered within the country, a large portion of the profits are repatriated to foreign investors or parent companies, thus not contributing to Ireland's GNI.

## 6 Conclusion

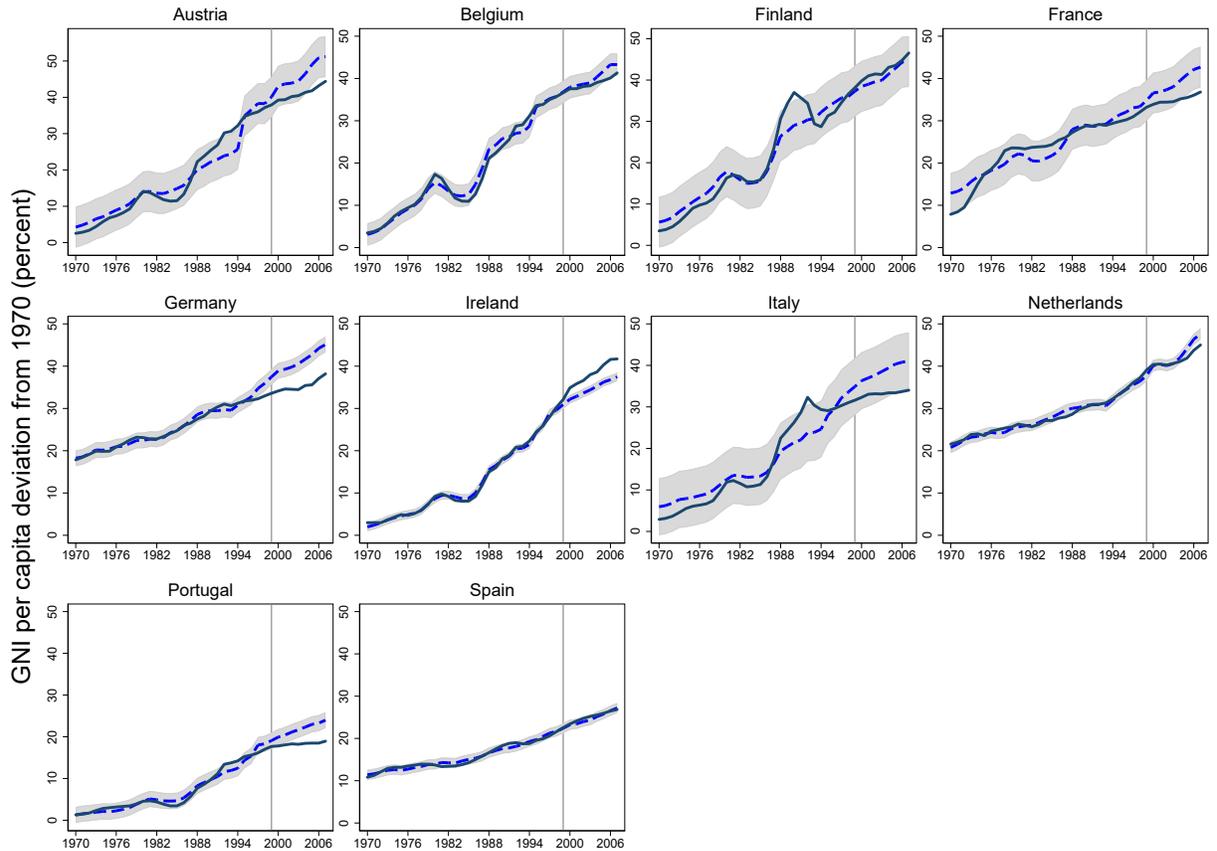
In this paper, we study the impact of the euro adoption on the macroeconomic performance of the first twelve Eurozone members. We use the synthetic control method to construct a counterfactual of these countries' GDP. This method allows building a doppelganger that aims at representing the economic activity of these countries in the absence of the euro.

Our findings suggest that there are mild losers (France, Germany, Italy, and Portugal) and a clear winner (Ireland). Notwithstanding, the drivers of such estimates are heterogeneous. First,

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<sup>18</sup>Following the Government's announcement in July 1998 to introduce a standard rate of corporation tax of 12.5% for trading income with effect from 1st January 2003, the Government has commenced the process of reducing the existing standard rate of corporation tax. Ireland's corporate tax rate of 12.5% is among the lowest in Europe, which has been a significant factor in attracting multinational companies.

Figure 6: The Impact of the Eurozone Accession - Gross National Income per capita



Notes: In each graph, the dashed line represents GNI per capita for the synthetic country and the continuous line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger before the euro accession. The vertical line represents the treatment period - 1999 for all countries except for Greece which is 2001. For each country, the analysis starts in 1970 and ends in 2007.

Ireland's economic gains are more modest when excluding profits and income earned by foreigners, while the results remain unchanged for other countries. Second, our GDP decomposition analysis indicates that for the majority of Eurozone countries, the euro spurred government consumption, while deterring investment and private consumption. The common currency also stimulated overall trade in the region, but only a few countries benefited from increased net exports.

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# **Adopting the Euro: a Synthetic Control Approach**

## **Online Appendix**

# Appendix A Appendix

## A.1 Variables Description and Source

Table A.1: Variables Description

Variable code	Description	Source
rgdpna	Real gross domestic product at constant 2011 national prices in million 2011 US dollars normalized to unity in 1970.	PWT 9.1
pop	Total population in millions.	PWT 9.1
rgdpnadc	Per head real gross domestic product at constant 2011 national prices in 2011 US dollars computed by dividing rgdpna by pop normalized to unity in 1970.	PWT 9.1
rgdpepc	Per head (expenditure side) real gross domestic product at chained PPPs 2011 US dollars computed by dividing rgdpe by pop normalized to unity in 1970.	PWT 9.1
emp	Total employment - number of persons engaged in millions.	PWT 9.1
csh_prod	Labor productivity growth computed by taking the log-difference between real gdp and total employment	PWT 9.1
csh_emp	Employment share - ratio between total employment and total population	PWT 9.1
csh_c	Private consumption expenditure (% of GDP) obtained by subtracting general government final consumption expenditure to the series of final consumption expenditure	World Bank
csh_g	General government final consumption expenditure (% of GDP)	World Bank
csh_i	Gross fixed capital formation (% of GDP)	World Bank
csh_x	Exports of goods and services (% of GDP)	World Bank
csh_m	Imports of goods and services (% of GDP)	World Bank
gnipc	Gross national income per capita	World Bank
inflation	Inflation rate (%), Consumer Price Index of All Commodities	IMF IFS

Notes: All variables collected directly from the Penn World Table are from version 9.1 (PWT 9.1) Feenstra et al. (2015). All level variables are in real terms and at annual frequency spanning the year 1970 until 2007. GDP components were collected from the World Bank database in shares of GDP. IMF IFS stands for the International Monetary Fund, International Financial Statistics (IFS) database.

## A.2 Comparison Tables

Table A.2: Predictors' Means (in %) during Pre-Treatment Period

Variable Names	Country	Doppelganger
<b>Austria</b>		
Share of Priv. Consumption	56.27	54.58
Share of Investment	26.53	26.02
Share of Gov. Consumption	17.91	17.39
Share of Imports	32.57	35.93
Share of Exports	31.85	33.92
Employment Share	45.16	48.31
Labor productivity growth	2.32	1.35
Inflation Rate	4.24	5.16
<b>Belgium</b>		
Share of Priv. Consumption	54.14	54.45
Share of Investment	22.87	28.49
Share of Gov. Consumption	21.41	14.42
Share of Imports	53.80	41.32
Share of Exports	55.39	38.67
Employment Share	38.01	50.64
Labor productivity growth	2.19	1.46
Inflation Rate	4.85	4.84
<b>Finland</b>		
Share of Priv. Consumption	52.51	50.11
Share of Investment	26.66	26.39
Share of Gov. Consumption	19.38	21.69
Share of Imports	26.57	33.64
Share of Exports	28.02	31.84
Employment Share	47.26	48.27
Labor productivity growth	2.99	2.16
Inflation Rate	6.73	6.72
<b>France</b>		
Share of Priv. Consumption	55.16	55.17
Share of Investment	23.11	23.08
Share of Gov. Consumption	21.24	20.72
Share of Imports	20.54	24.69
Share of Exports	21.03	23.66
Employment Share	40.49	44.51
Labor productivity growth	2.11	1.15
Inflation Rate	6.22	11.59
<b>Germany</b>		
Share of Priv. Consumption	57.15	58.33
Share of Investment	24.50	25.60
Share of Gov. Consumption	19.68	14.79
Share of Imports	21.40	31.43
Share of Exports	20.06	30.15
Employment Share	48.36	49.07
Labor productivity growth	2.35	1.03
Inflation Rate	3.54	4.54
<b>Greece</b>		
Share of Priv. Consumption	63.06	62.61
Share of Investment	26.46	22.01
Share of Gov. Consumption	16.75	15.77

*Continued on next page...*

... table A.2 continued

<b>Variable Names</b>	<b>Country</b>	<b>Doppelganger</b>
Share of Imports	21.77	23.49
Share of Exports	15.50	23.87
Employment Share	38.77	41.82
Labor productivity growth	1.44	0.97
Inflation Rate	14.70	15.28
<b>Ireland</b>		
Share of Priv. Consumption	61.17	55.84
Share of Investment	21.65	25.10
Share of Gov. Consumption	18.72	19.06
Share of Imports	52.85	32.05
Share of Exports	51.30	32.05
Employment Share	35.36	40.78
Labor productivity growth	3.44	2.28
Inflation Rate	8.36	33.46
<b>Italy</b>		
Share of Priv. Consumption	59.00	62.10
Share of Investment	22.87	22.38
Share of Gov. Consumption	17.55	16.95
Share of Imports	19.28	19.64
Share of Exports	19.86	21.07
Employment Share	38.25	42.35
Labor productivity growth	2.16	1.56
Inflation Rate	9.48	11.20
<b>Luxembourg</b>		
Share of Priv. Consumption	48.16	57.18
Share of Investment	22.57	28.27
Share of Gov. Consumption	15.33	14.76
Share of Imports	81.83	39.39
Share of Exports	95.78	39.60
Employment Share	46.63	49.28
Labor productivity growth	1.91	1.42
Inflation Rate	4.61	14.66
<b>The Netherlands</b>		
Share of Priv. Consumption	50.90	54.78
Share of Investment	22.62	26.16
Share of Gov. Consumption	21.94	18.40
Share of Imports	47.47	38.27
Share of Exports	52.01	37.62
Employment Share	43.78	49.70
Labor productivity growth	1.45	1.40
Inflation Rate	4.18	12.26
<b>Portugal</b>		
Share of Priv. Consumption	66.93	64.53
Share of Investment	26.93	21.90
Share of Gov. Consumption	14.03	15.06
Share of Imports	31.16	22.84
Share of Exports	23.27	24.34
Employment Share	41.81	41.35
Labor productivity growth	1.95	1.75
Inflation Rate	14.14	14.12
<b>Spain</b>		

Continued on next page...

... table A.2 continued

<b>Variable Names</b>	<b>Country</b>	<b>Doppelganger</b>
Share of Priv. Consumption	63.12	65.77
Share of Investment	23.78	20.50
Share of Gov. Consumption	14.51	15.36
Share of Imports	18.55	20.84
Share of Exports	17.13	22.47
Employment Share	35.38	39.80
Labor productivity growth	2.55	1.44
Inflation Rate	9.87	16.90

Notes: Predictors' means for each country and its doppelgangers during the pre-treatment period. The doppelganger column corresponds to a simple (non-weighted) average and thus some discrepancies may arise because of that. All numbers are in percent. Variables definitions can be found in Table A.1.

## A.3 Weights Table

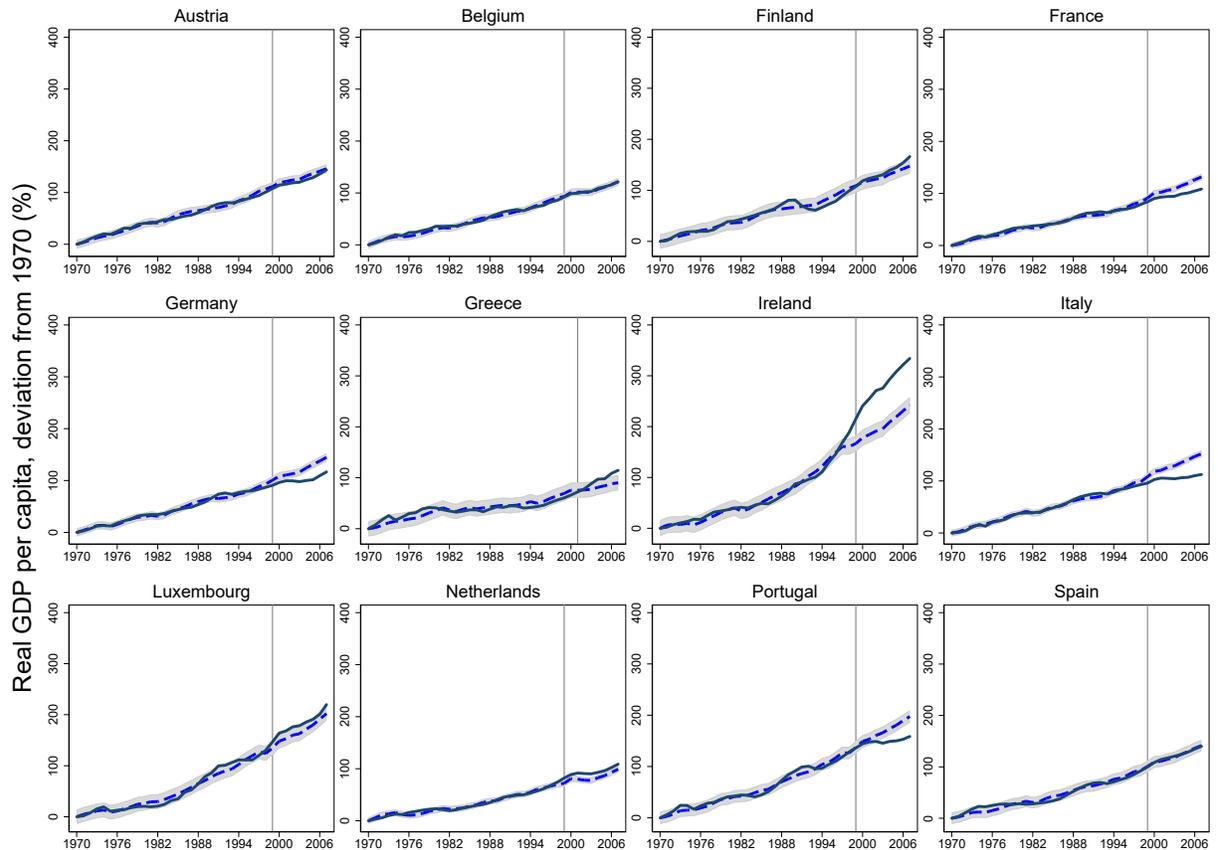
Table A.3: Composition of the Doppelgangers: Country Weights (in %)

<i>Donor countries</i>	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
Australia	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	26.7	< 0.1	< 0.1	< 0.1	< 0.1
Canada	36.5	< 0.1	< 0.1	30.7	25.5	< 0.1	< 0.1	8.7	< 0.1	< 0.1	< 0.1	< 0.1
Chile	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4	29.0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Denmark	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	26.4	< 0.1	< 0.1
Iceland	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Israel	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	15.1	< 0.1	18.6	13.5	< 0.1	< 0.1
Korea	< 0.1	< 0.1	< 0.1	< 0.1	1.1	< 0.1	4.4	< 0.1	9.3	< 0.1	6.9	0.4
Mexico	< 0.1	< 0.1	< 0.1	18.5	< 0.1	24.2	< 0.1	13.9	< 0.1	< 0.1	23.3	32.5
New Zealand	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	52.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Norway	29.5	41.9	53.2	< 0.1	< 0.1	< 0.1	51.4	< 0.1	< 0.1	13.0	< 0.1	< 0.1
Sweden	< 0.1	< 0.1	41.3	44.6	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Switzerland	34.1	58.1	< 0.1	< 0.1	51.3	< 0.1	< 0.1	< 0.1	72.1	47.1	7.4	< 0.1
United Kingdom	< 0.1	< 0.1	5.5	< 0.1	< 0.1	23.3	< 0.1	45.2	< 0.1	< 0.1	59.6	67.1
United States	< 0.1	< 0.1	< 0.1	6.2	22.1	< 0.1	< 0.1	5.6	< 0.1	< 0.1	2.8	< 0.1

Notes: This table summarizes the weights in percent attributed to each donor country to construct the synthetic treated units. These weights are used in the baseline analysis.

## A.4 GDP per capita

Figure A.1: The Impact of the Eurozone Accession - Real GDP per capita



Notes: In each graph, the dashed line represents the normalized real GDP per capita for the synthetic country and the continuous line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger before the euro accession. The vertical line represents the treatment period - 1999 for all countries except for Greece which is 2001. For each country, the analysis starts in 1970 and ends in 2007.

## A.5 RMSPE

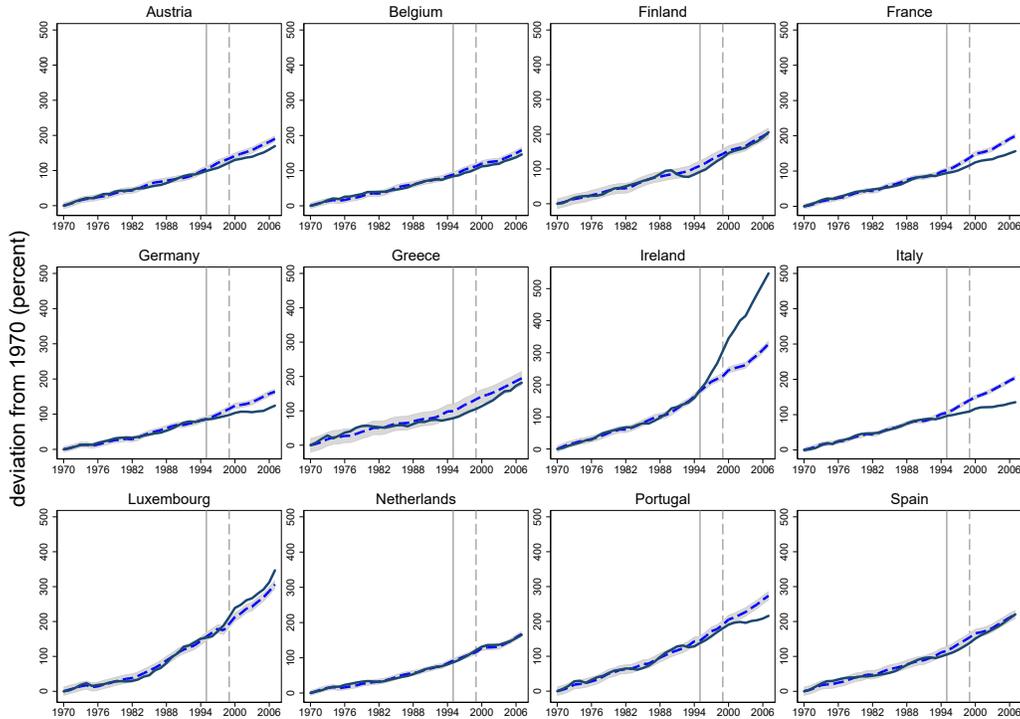
Table A.4: RMSPE of the Pre-Treatment Doppelganger gap

	<i>AUS</i>	<i>CAN</i>	<i>CHL</i>	<i>DNK</i>	<i>ISL</i>	<i>ISR</i>	<i>KOR</i>	<i>MEX</i>	<i>NZL</i>	<i>NOR</i>	<i>SWE</i>	<i>CHE</i>	<i>GBR</i>	<i>USA</i>	<i>Treated</i>
<i>AUT</i>	0.02	0.02	0.34	0.03	0.13	0.12	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.01	0.03
<i>BEL</i>	0.02	0.02	0.34	0.03	0.16	0.10	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.01	0.04
<i>FIN</i>	0.01	0.02	0.34	0.03	0.13	0.10	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.01	0.04
<i>FRA</i>	0.02	0.02	0.34	0.03	0.16	0.09	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.01	0.03
<i>DEU</i>	0.02	0.02	0.34	0.03	0.15	0.09	3.26	0.11	0.06	0.03	0.04	0.11	0.02	0.02	0.03
<i>GRC</i>	0.02	0.02	0.24	0.02	0.13	0.11	3.68	0.10	0.06	0.04	0.03	0.13	0.02	0.02	0.09
<i>IRL</i>	0.01	0.02	0.24	0.03	0.15	0.08	3.26	0.11	0.06	0.04	0.03	0.11	0.02	0.01	0.08
<i>ITA</i>	0.02	0.02	0.24	0.03	0.13	0.12	3.26	0.11	0.06	0.03	0.04	0.11	0.02	0.01	0.04
<i>LUX</i>	0.01	0.02	0.34	0.03	0.19	0.10	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.01	0.07
<i>NLD</i>	0.02	0.02	0.34	0.03	0.13	0.09	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.02	0.04
<i>PRT</i>	0.01	0.02	0.24	0.03	0.13	0.10	3.26	0.11	0.06	0.03	0.03	0.11	0.02	0.02	0.06
<i>ESP</i>	0.02	0.02	0.24	0.03	0.13	0.10	3.26	0.11	0.06	0.03	0.04	0.11	0.02	0.02	0.06

Notes: This table presents the RMSPE for the pre-treatment period, a measure of the pre-treatment fit, and the denominator for the statistic presented in Table 2 of the draft: Relative RMSPE of the Pre- and Post-Treatment Doppelganger gaps.

## A.6 In-Time Placebo Test

Figure A.2: In-Time Placebo Test - 1995

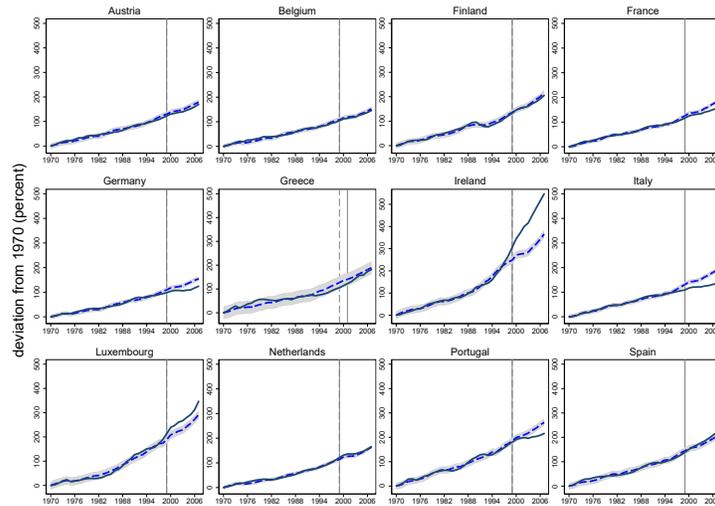


Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession. The vertical line depicts the placebo treatment period - 1995 for all countries. For all countries the analysis starts in 1970 and ends in 2007.

## A.7 Changing Donor Pool

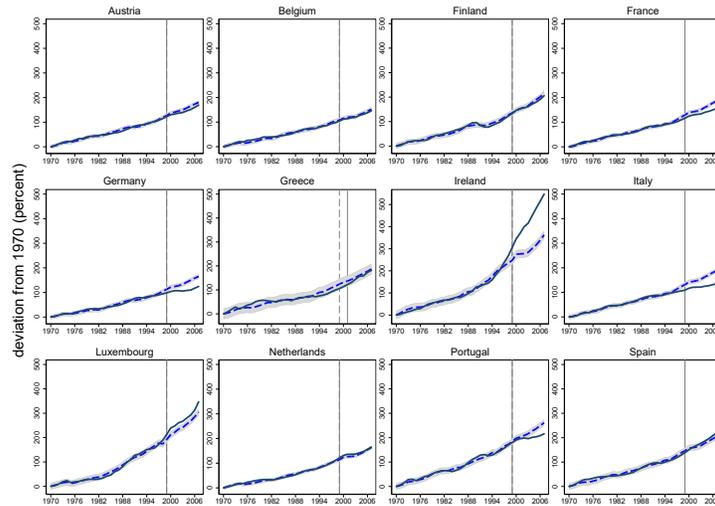
In each of the following set of graphs, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The vertical line depicts the treatment period. For all countries the analysis starts in 1970 and ends in 2007. We iteratively exclude different countries from the donor pool as argued in Section 3.3.

Figure A.3: SCM without Canada



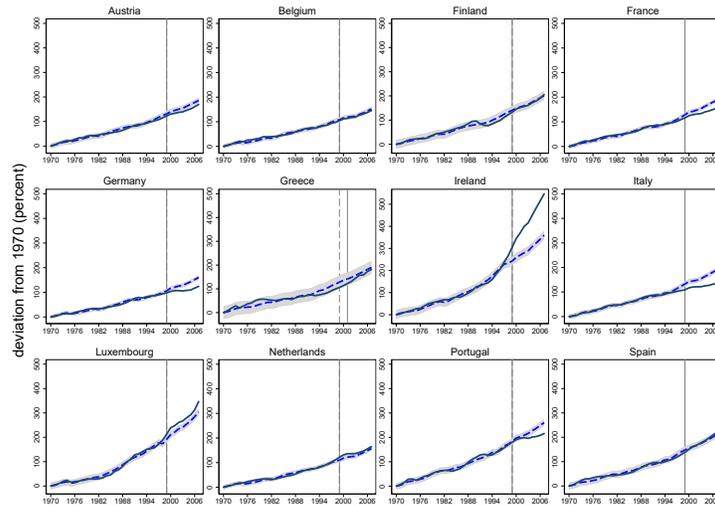
Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Canada is excluded from the donor pool.

Figure A.4: SCM without Chile



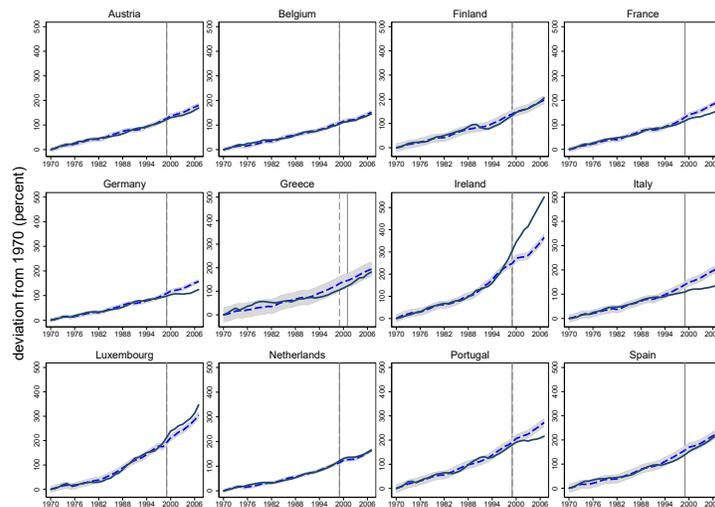
Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Chile is excluded from the donor pool.

Figure A.5: SCM without Israel



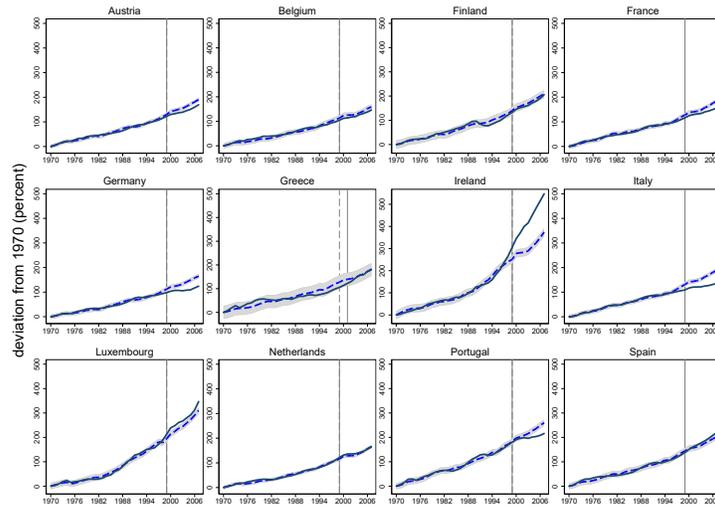
Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Israel is excluded from the donor pool.

Figure A.6: SCM without Mexico



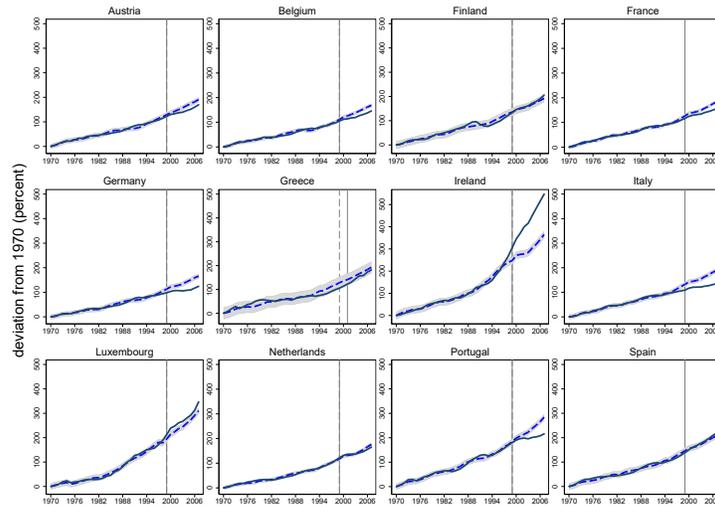
Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Mexico is excluded from the donor pool.

Figure A.7: SCM without Norway



Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Norway is excluded from the donor pool.

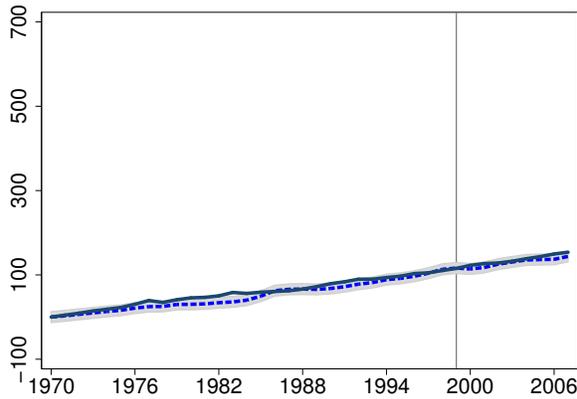
Figure A.8: SCM without Switzerland



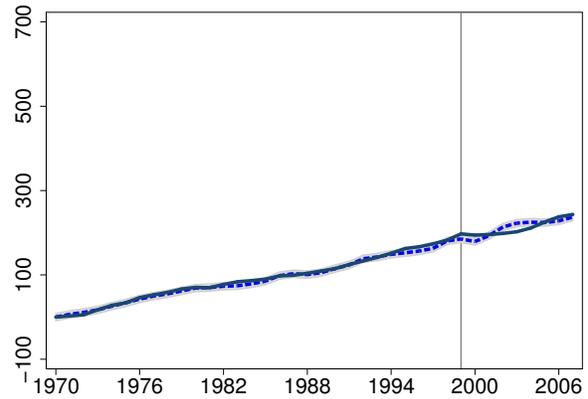
Notes: In each graph, the blue dashed line represents the normalized real GDP for the synthetic country and the black full line represents the series for the actual country. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelgänger prior to the euro accession. The vertical line depicts the placebo treatment period - 2001 for Greece and 1999 for all other countries. For all countries the analysis starts in 1970 and ends in 2007. Switzerland is excluded from the donor pool.

## **Appendix B   Components Analysis**

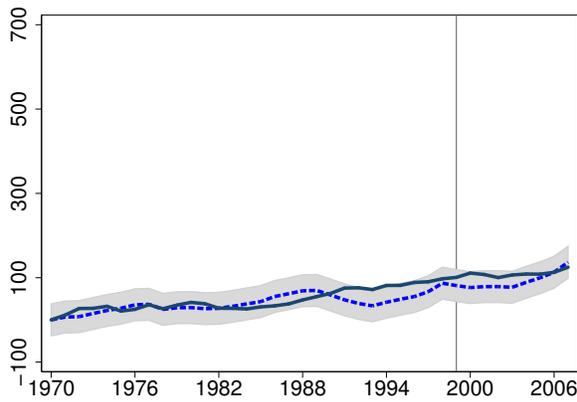
Figure B.9: Components of Austria's GDP



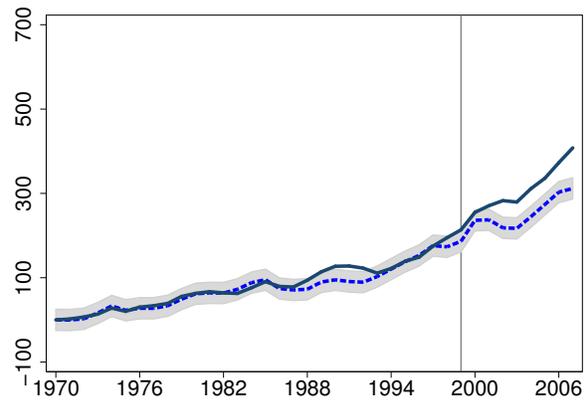
(a) Private Consumption



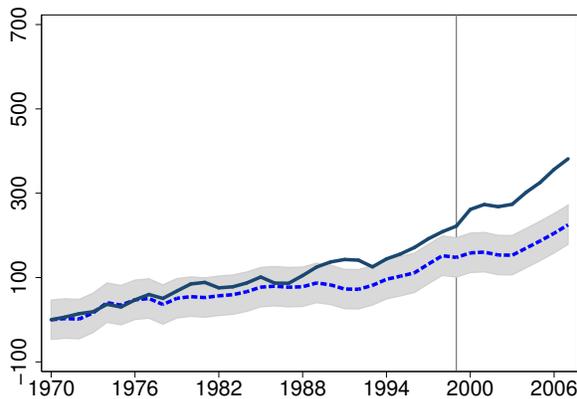
(b) Government Consumption



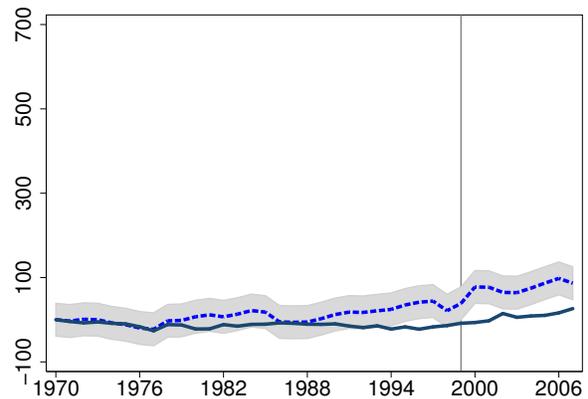
(c) Investment



(d) Exports



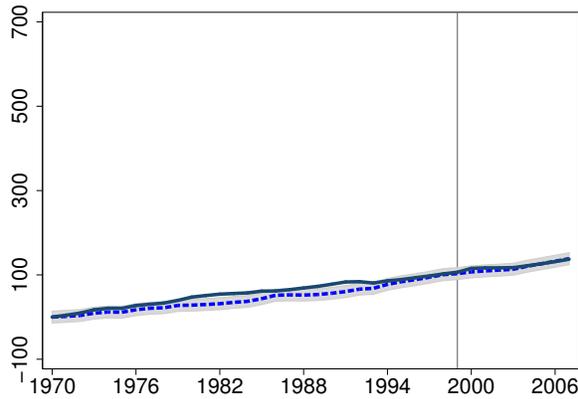
(e) Imports



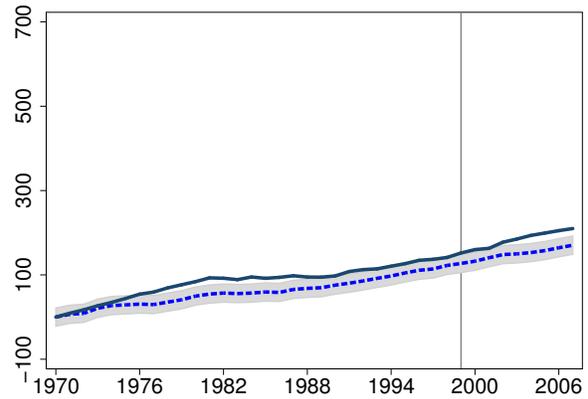
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Austria computed in section 2. The full black lines stand for the actual Austrian series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

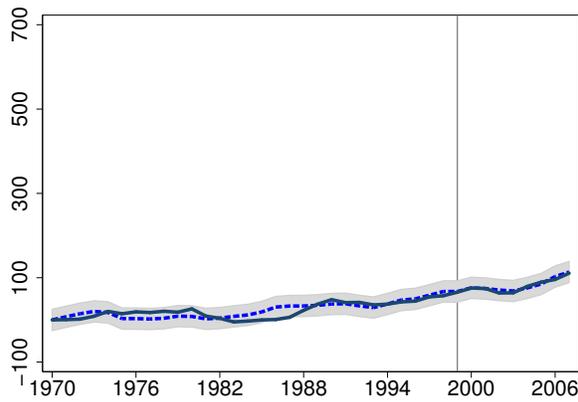
Figure B.10: Components of Belgium's GDP



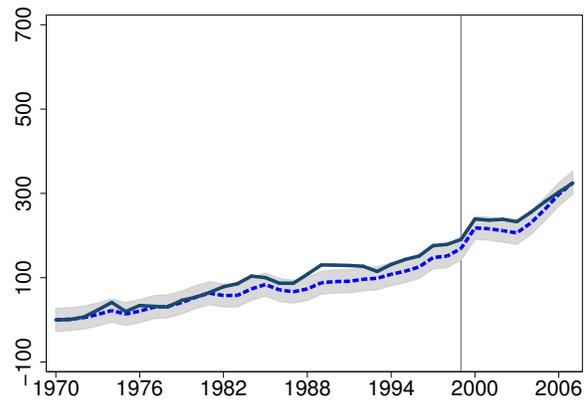
(a) Private Consumption



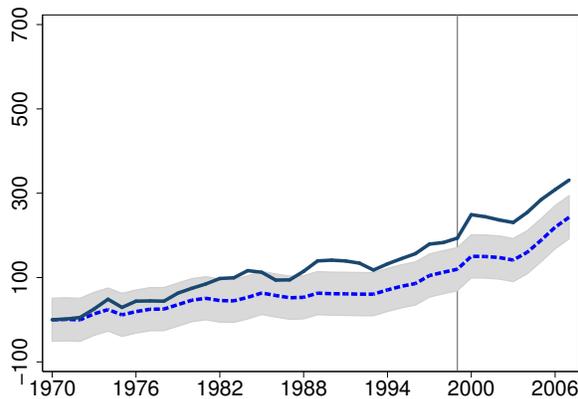
(b) Government Consumption



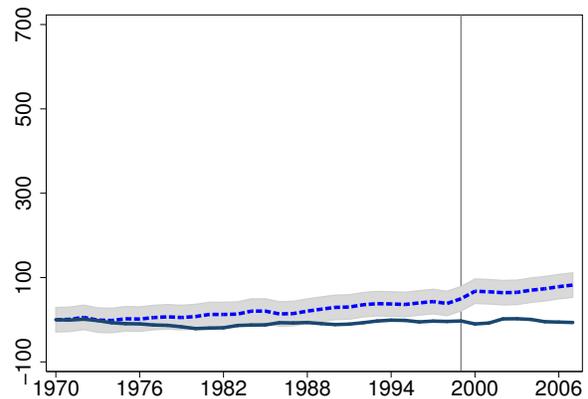
(c) Investment



(d) Exports



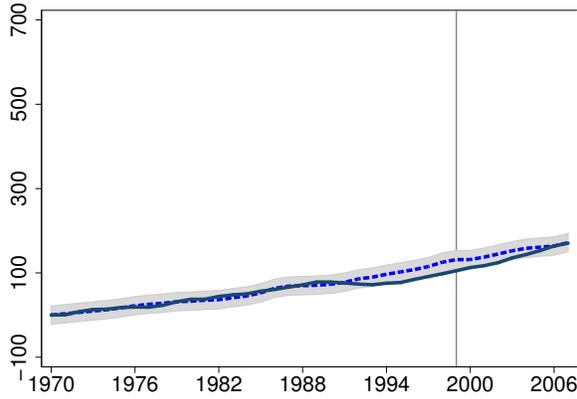
(e) Imports



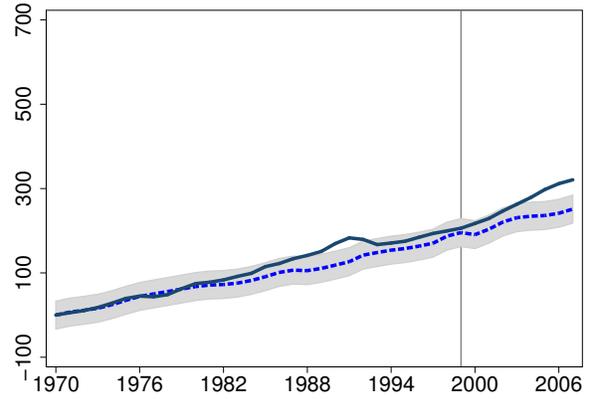
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Austria computed in section 2. The full black lines stand for the actual Belgian series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

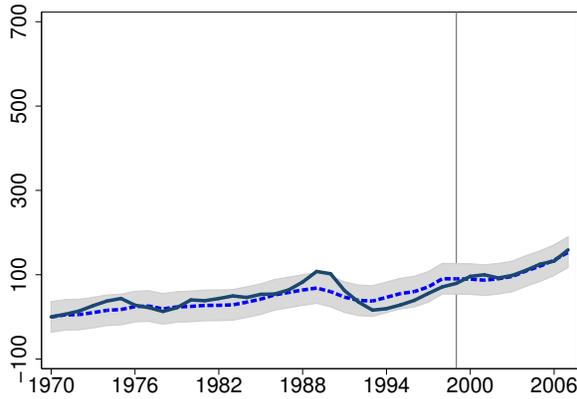
Figure B.11: Components of Finland's GDP



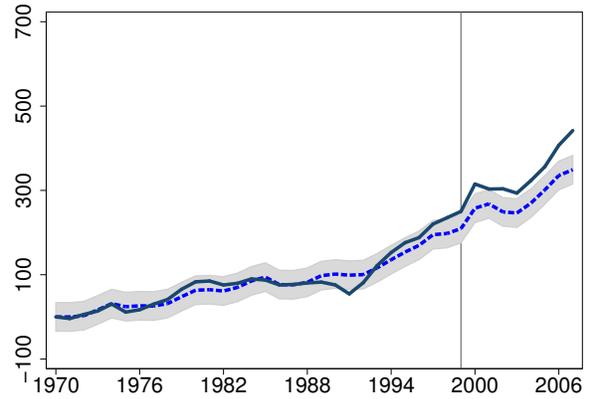
(a) Private Consumption



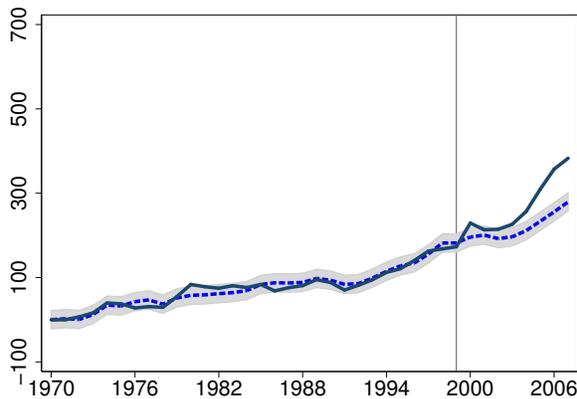
(b) Government Consumption



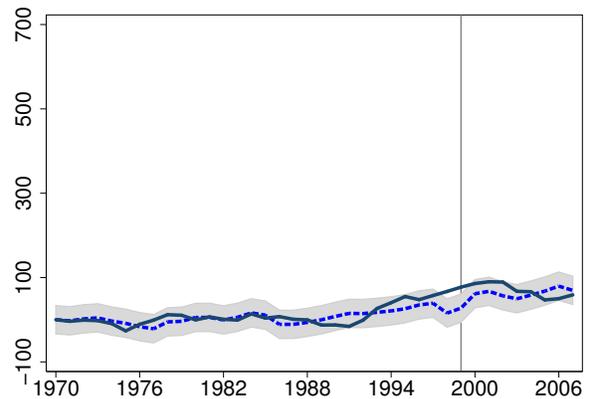
(c) Investment



(d) Exports



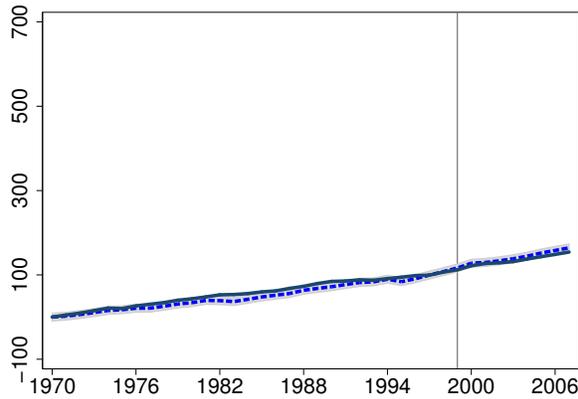
(e) Imports



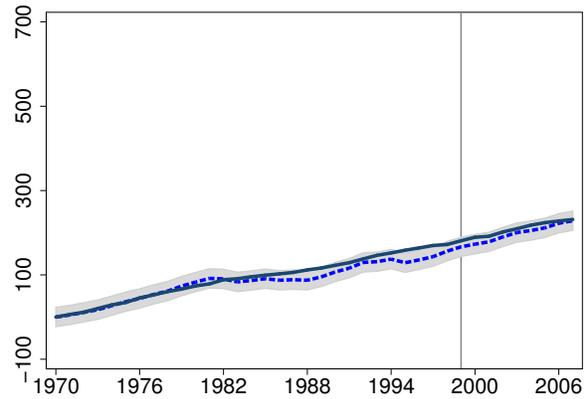
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Belgium computed in section 2. The full black lines stand for the actual Finnish series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

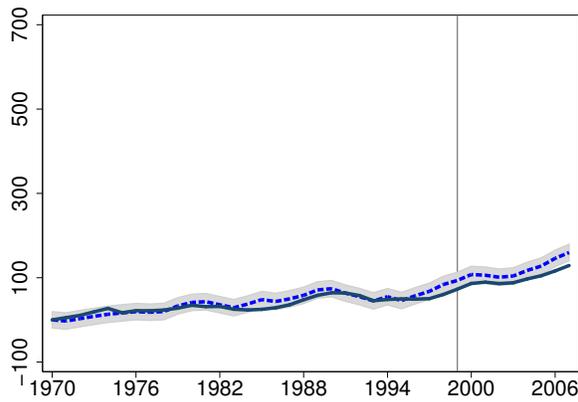
Figure B.12: Components of France's GDP



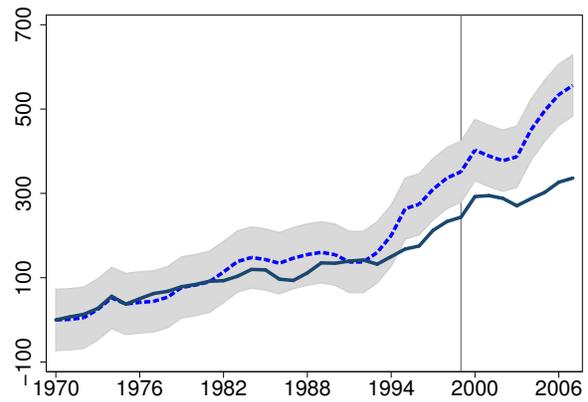
(a) Private Consumption



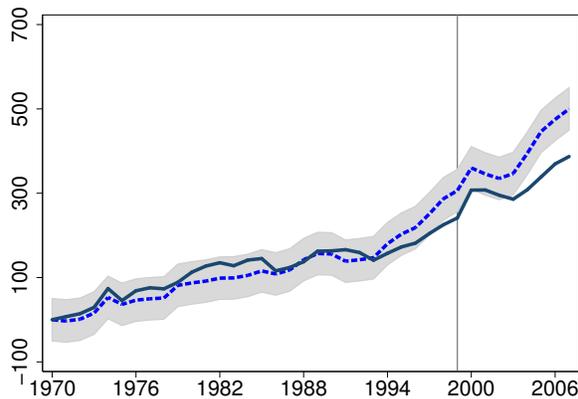
(b) Government Consumption



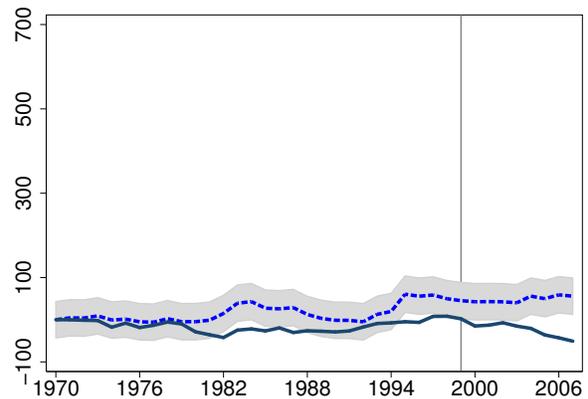
(c) Investment



(d) Exports



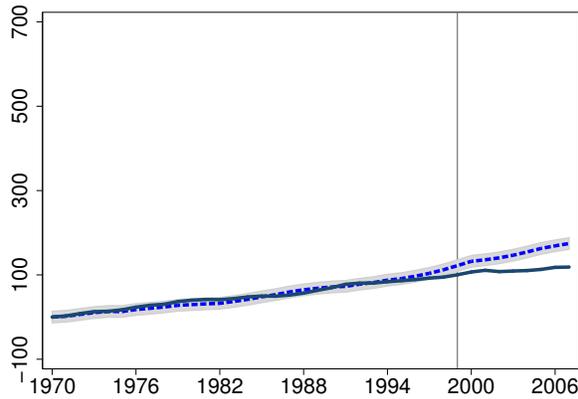
(e) Imports



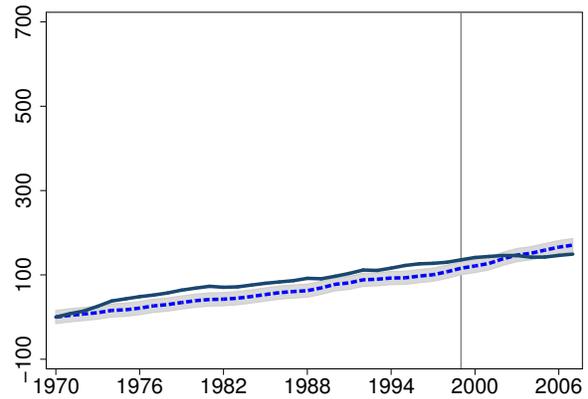
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic France computed in section 2. The full black lines stand for the actual French series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

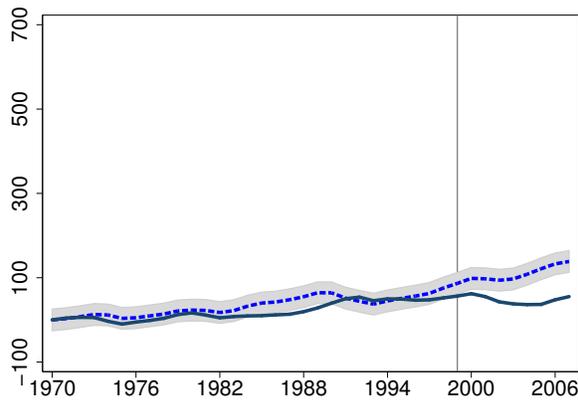
Figure B.13: Components of Germany's GDP



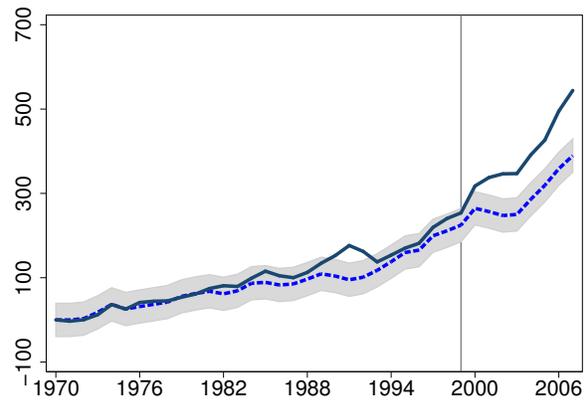
(a) Private Consumption



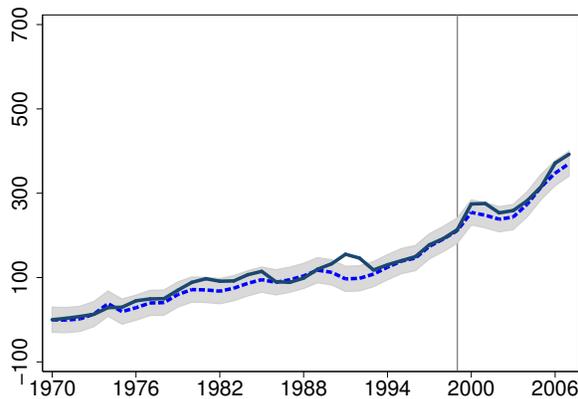
(b) Government Consumption



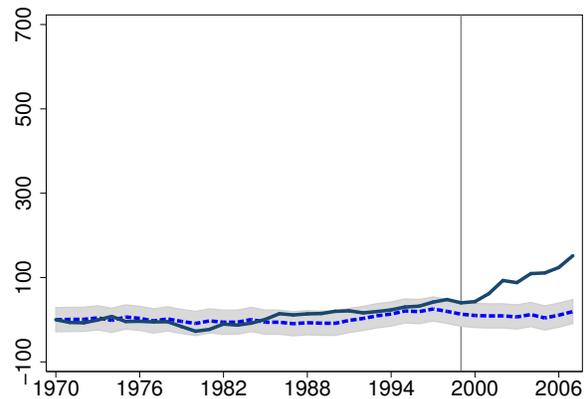
(c) Investment



(d) Exports



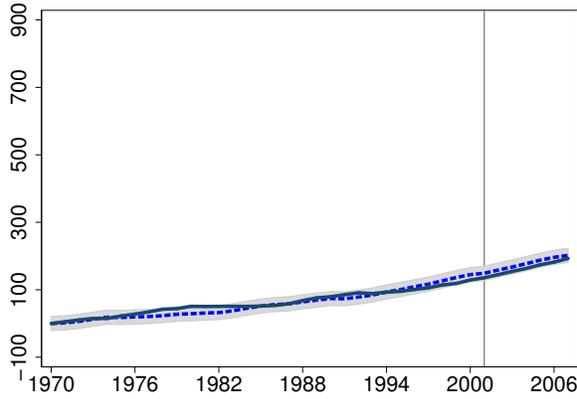
(e) Imports



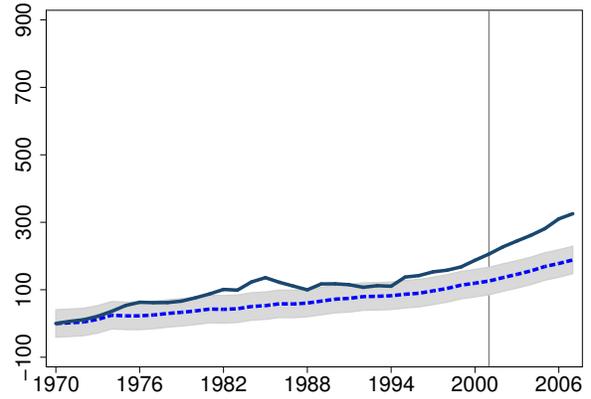
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Germany computed in section 2. The full black lines stand for the actual German series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

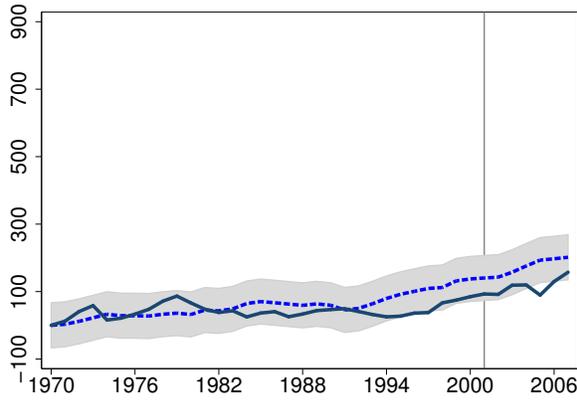
Figure B.14: Components of Greece's GDP



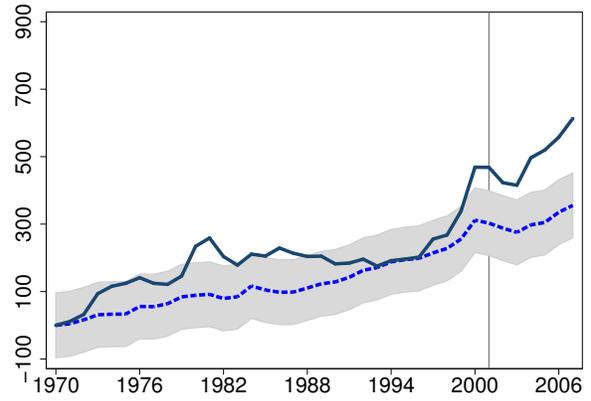
(a) Private Consumption



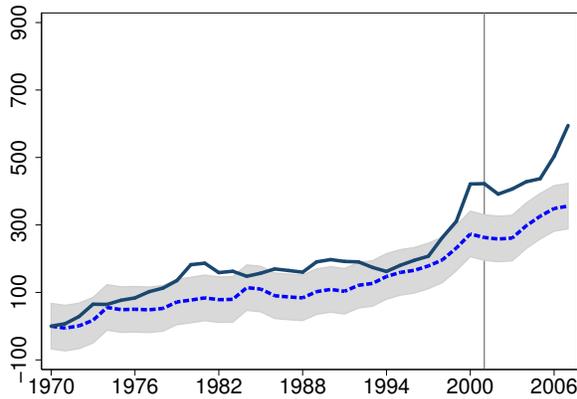
(b) Government Consumption



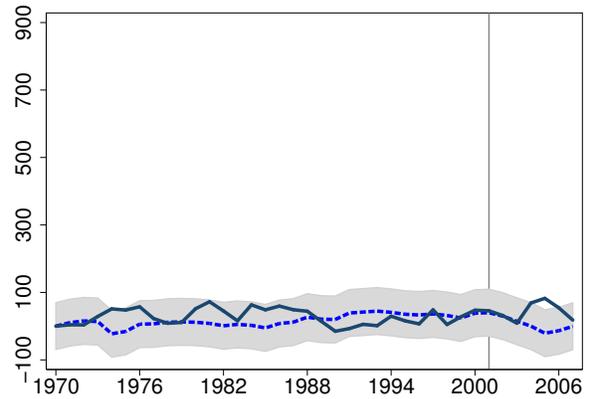
(c) Investment



(d) Exports



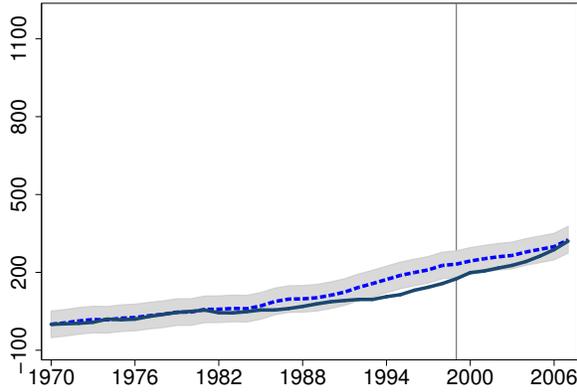
(e) Imports



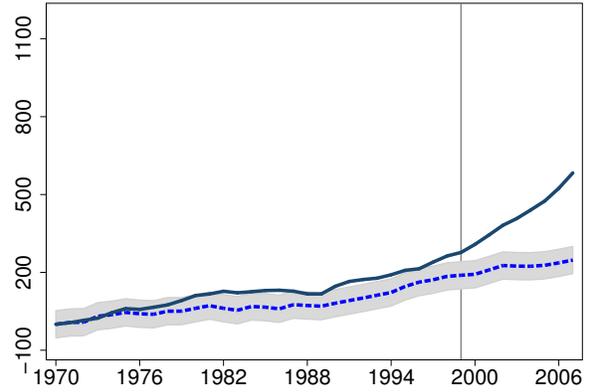
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Greece computed in section 2. The full black lines stand for the actual Greek series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

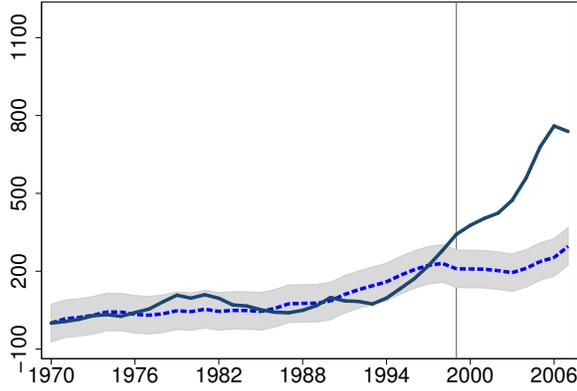
Figure B.15: Components of Ireland's GDP



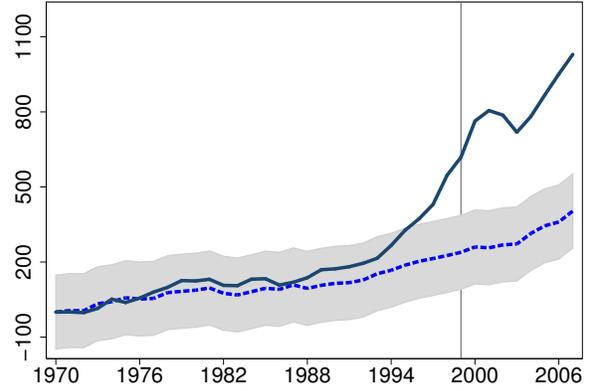
(a) Private Consumption



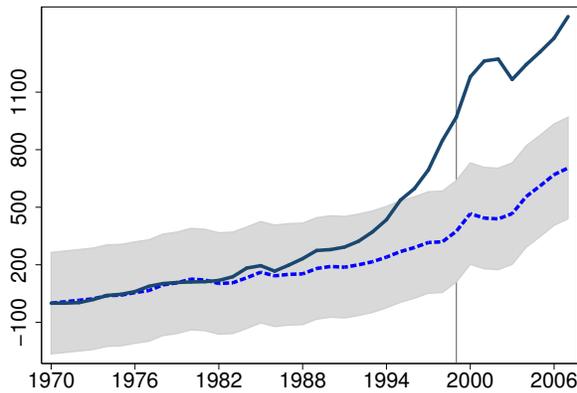
(b) Government Consumption



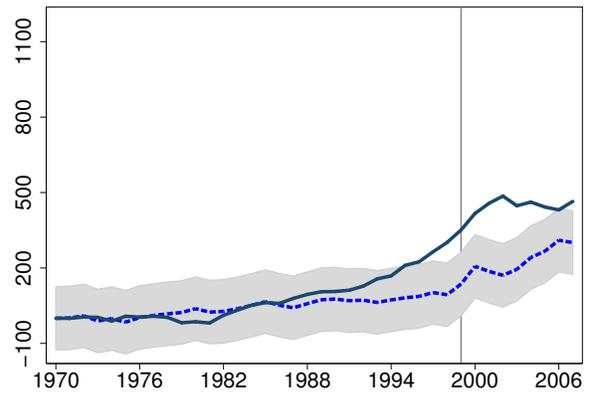
(c) Investment



(d) Exports



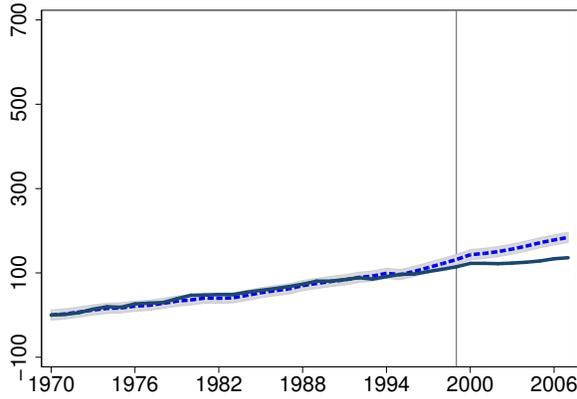
(e) Imports



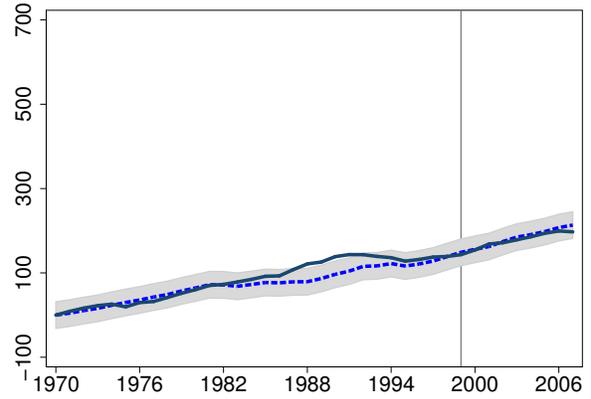
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Ireland computed in section 2. The full black lines stand for the actual Irish series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

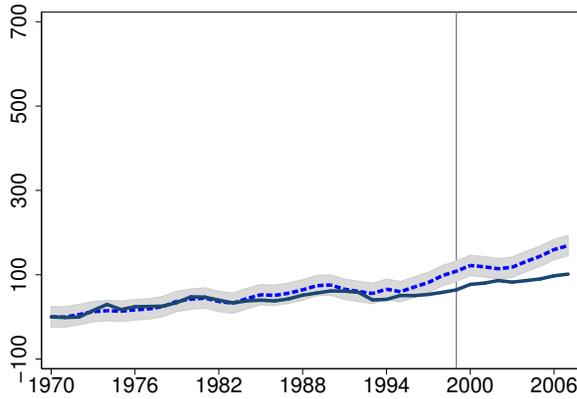
Figure B.16: Components of Italy's GDP



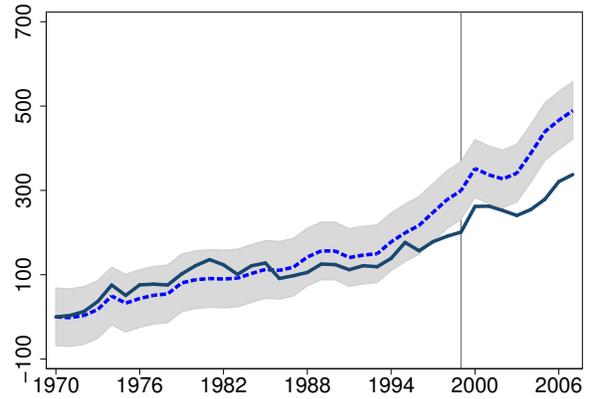
(a) Private Consumption



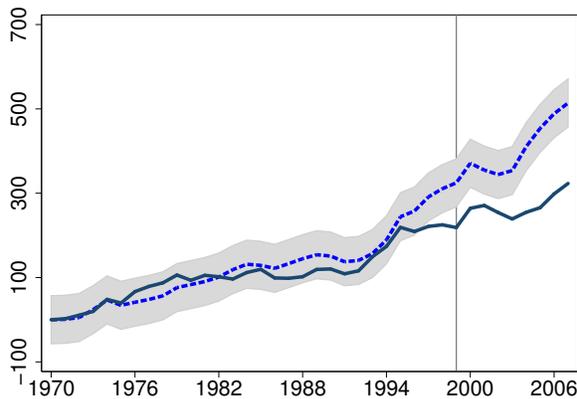
(b) Government Consumption



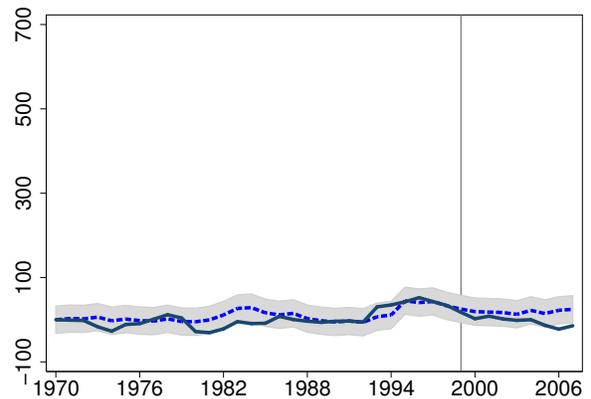
(c) Investment



(d) Exports



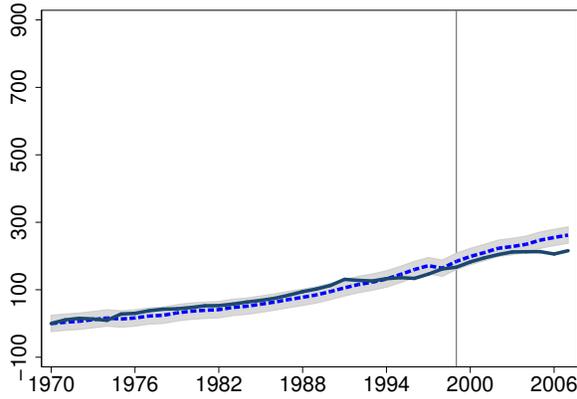
(e) Imports



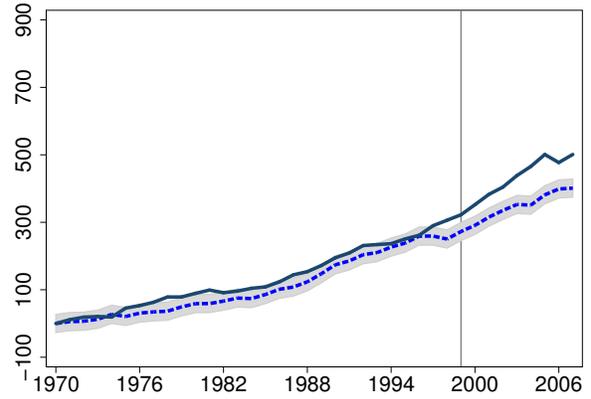
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Italy computed in section 2. The full black lines stand for the actual Italian series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

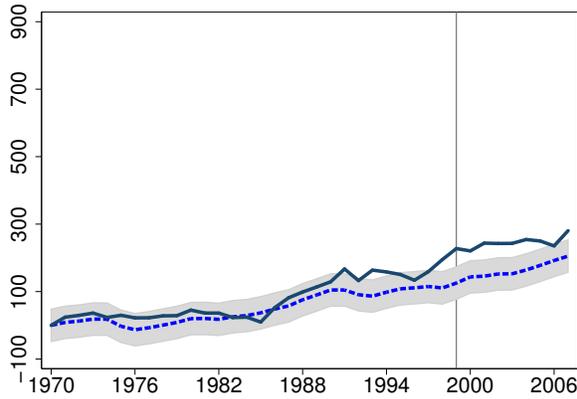
Figure B.17: Components of Luxembourg's GDP



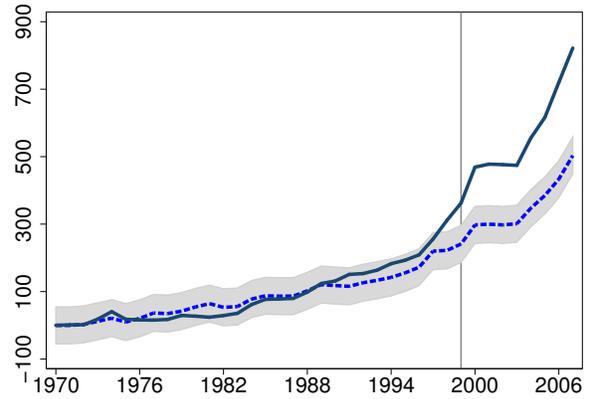
(a) Private Consumption



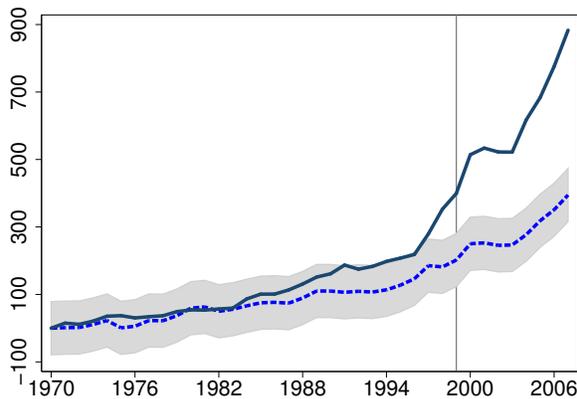
(b) Government Consumption



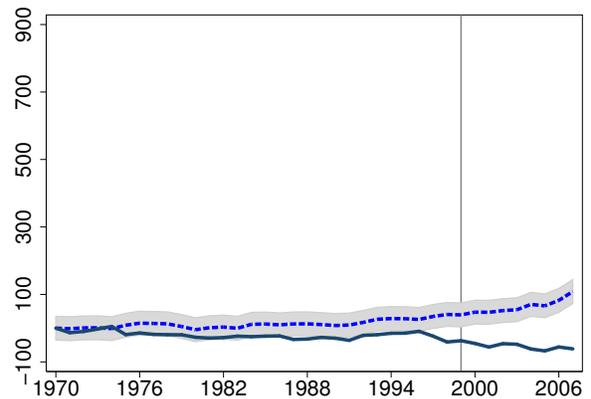
(c) Investment



(d) Exports



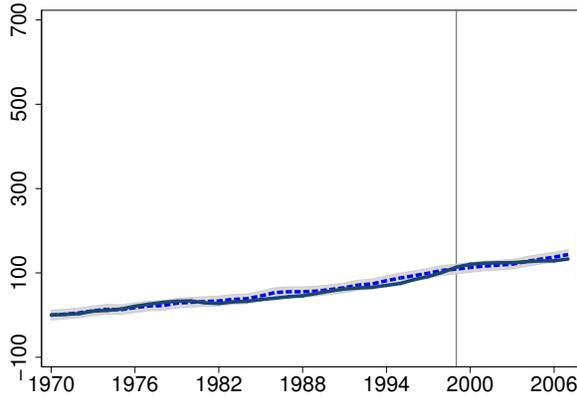
(e) Imports



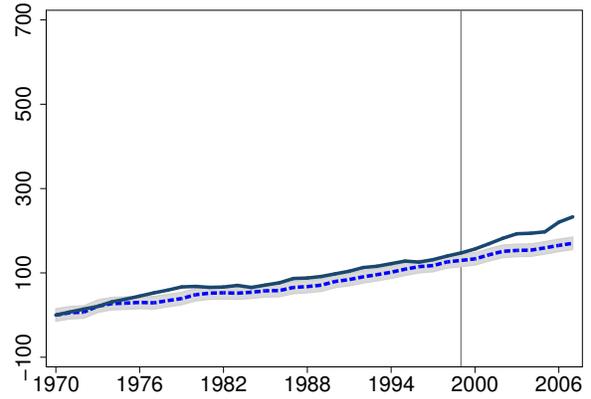
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Luxembourg computed in section 2. The full black lines stand for the actual Luxembourg's series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

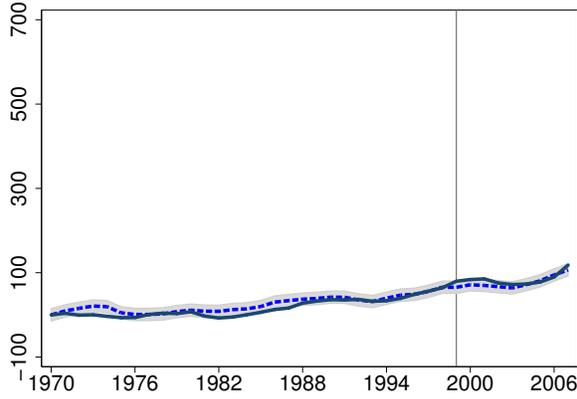
Figure B.18: Components of The Netherlands's GDP



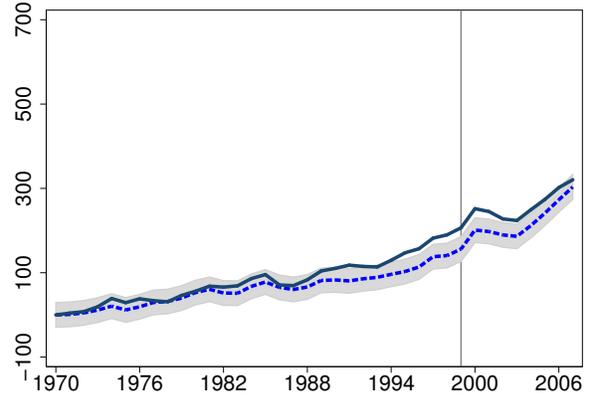
(a) Private Consumption



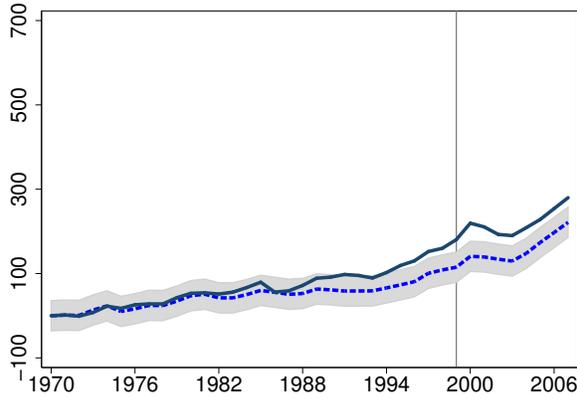
(b) Government Consumption



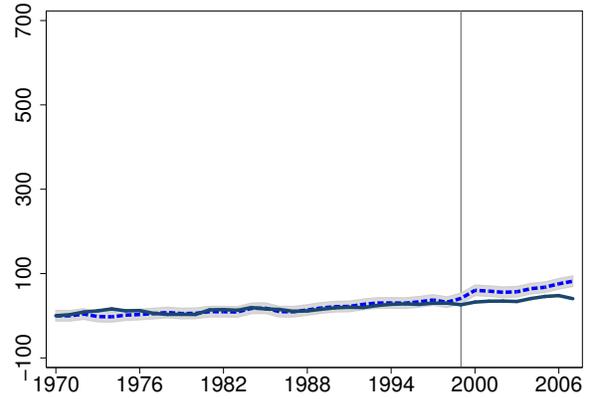
(c) Investment



(d) Exports



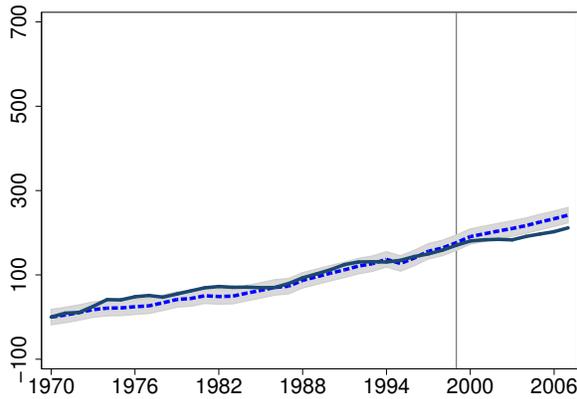
(e) Imports



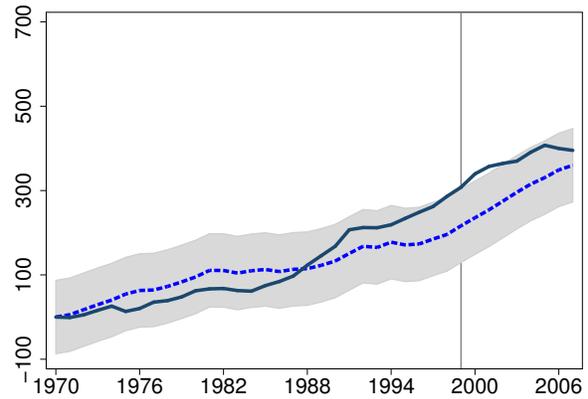
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Netherlands computed in section 2. The full black lines stand for the actual Dutch series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

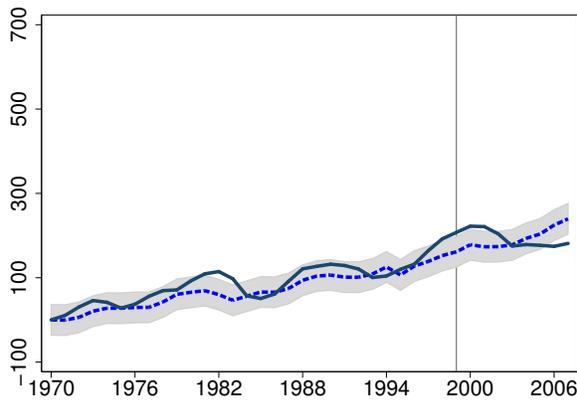
Figure B.19: Components of Portugal's GDP



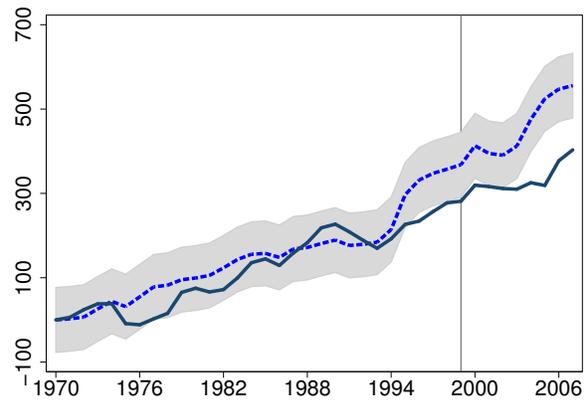
(a) Private Consumption



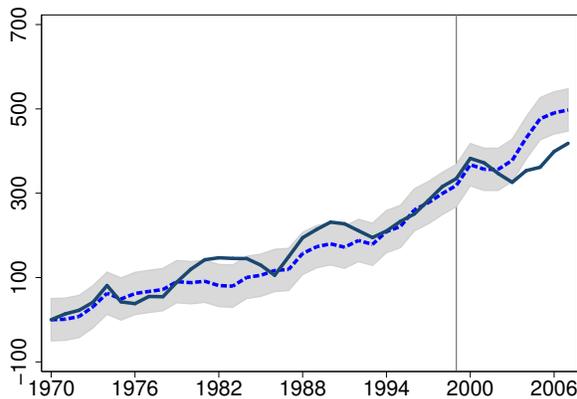
(b) Government Consumption



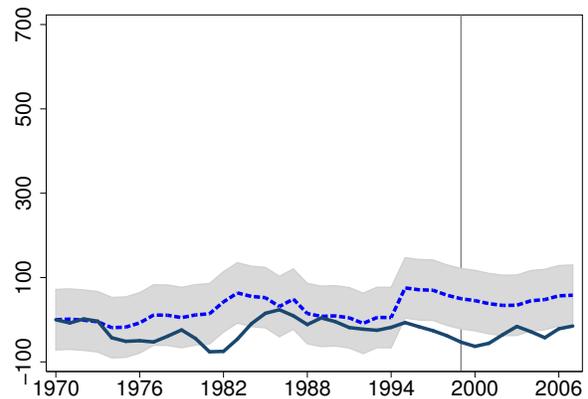
(c) Investment



(d) Exports



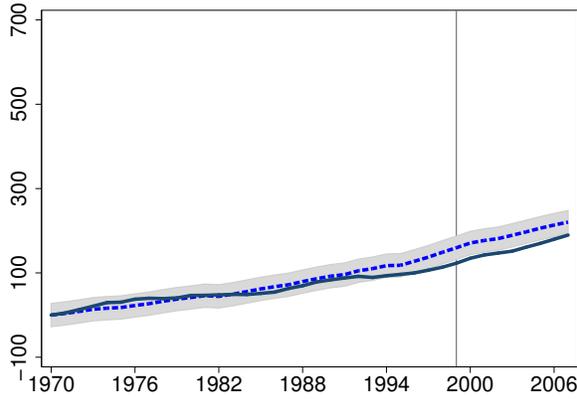
(e) Imports



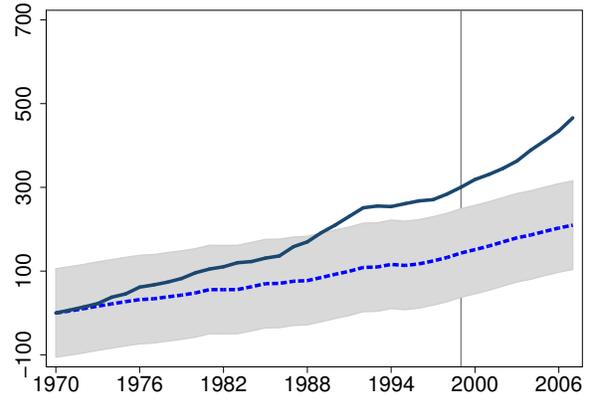
(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Portugal computed in section 2. The full black lines stand for the actual Portuguese series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

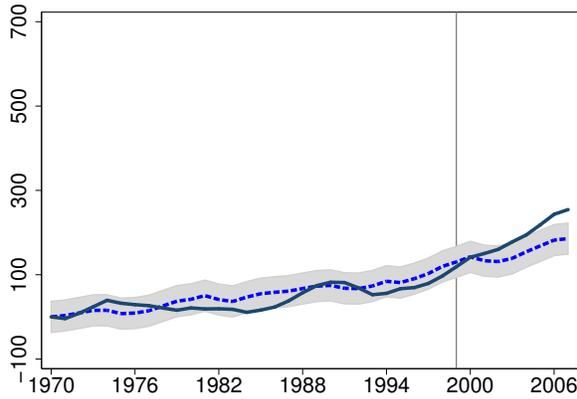
Figure B.20: Components of Spain's GDP



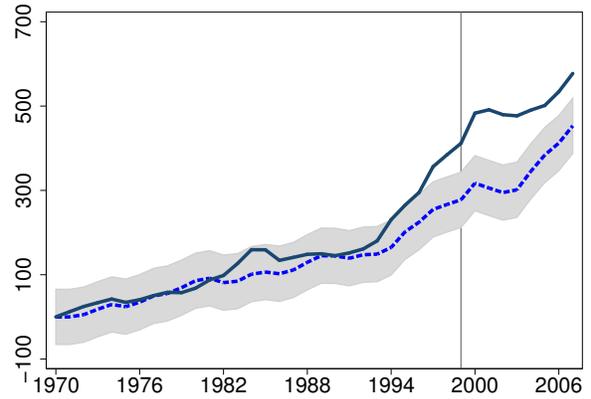
(a) Private Consumption



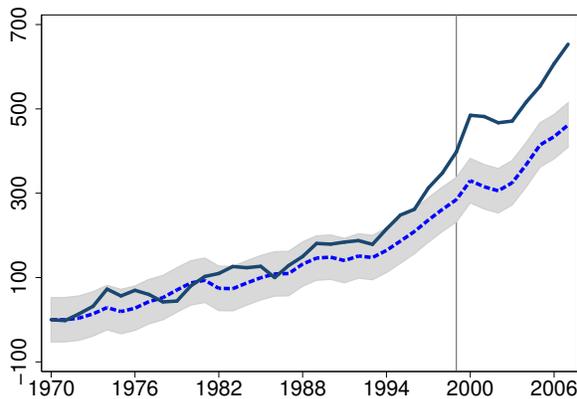
(b) Government Consumption



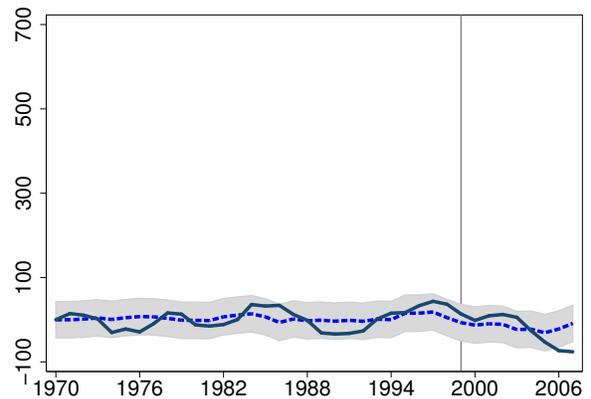
(c) Investment



(d) Exports



(e) Imports



(f) Net Exports

Notes: The plots depict, for each GDP component, the deviation in percent from the value of 1970. The blue dashed lines represents the synthetic Spain computed in section 2. The full black lines stand for the actual Spanish series. The shaded area corresponds to two standard deviations of the difference between the treated country and the doppelganger prior to the euro accession.

Table B.5: Composition of the Doppelgangers: Country Weights (in %)

<i>Donor countries</i>	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
Australia	< 0.1	< 0.1	< 0.1	27.2	< 0.1	< 0.1	< 0.1	13.4	< 0.1	< 0.1	< 0.1	< 0.1
Canada	< 0.1	< 0.1	67.7	37.4	23.0	12.8	< 0.1	27.4	< 0.1	< 0.1	< 0.1	< 0.1
Chile	< 0.1	< 0.1	< 0.1	0.1	< 0.1	1.7	22.0	< 0.1	5.2	< 0.1	< 0.1	< 0.1
Iceland	< 0.1	< 0.1	9.6	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Israel	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	50.1	< 0.1	56.0	12.0	< 0.1	< 0.1
Korea	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	4.4	< 0.1
Mexico	23.2	< 0.1	< 0.1	< 0.1	< 0.1	19.6	< 0.1	11.9	< 0.1	< 0.1	42.4	22.2
New Zealand	7.5	< 0.1	< 0.1	19.8	< 0.1	65.9	< 0.1	39.7	< 0.1	< 0.1	< 0.1	8.2
Norway	25.3	41.9	< 0.1	< 0.1	< 0.1	< 0.1	27.9	< 0.1	< 0.1	22.6	< 0.1	< 0.1
Switzerland	44.0	58.1	22.7	< 0.1	43.1	< 0.1	< 0.1	< 0.1	44.0	65.4	31.4	19.7
United States	< 0.1	< 0.1	< 0.1	15.5	33.9	< 0.1	< 0.1	7.6	< 0.1	< 0.1	21.8	49.9

Notes: This table summarizes the weights in percent attributed to each donor country to construct the synthetic treated units. Relative to the baseline analysis, the donor pool now excludes Denmark, Sweden and the United Kingdom.

## B.1 What Explains the Doppelganger Gap?

Table B.6: What Explains the Cumulative Doppelganger Gap?

	Private Consumption	Government Consumption	Investment	Net Exports	Doppelganger Gap	
	(%)	(%)	(%)	(%)	(%)	€ per capita
<b>Austria</b>	0.80	2.20	-1.24	-3.98	-2.22	-682.34
<b>Belgium</b>	0.35	6.87	-1.36	-8.24	-2.39	-678.66
<b>Finland</b>	7.10	0.50	1.52	-4.60	4.52	1,268.80
<b>France</b>	-4.50	0.65	-2.58	-3.20	-9.62	-2,843.31
<b>Germany</b>	-10.24	1.53	-6.30	0.98	-14.02	-4,863.67
<b>Greece</b>	3.41	3.70	3.78	-11.62	-0.74	-153.15
<b>Ireland</b>	15.76	6.65	17.35	0.23	40.00	10,960.80
<b>Italy</b>	-15.40	-2.53	-4.80	1.38	-21.35	-7,350.99
<b>Luxembourg</b>	-17.05	4.02	-3.06	30.07	13.97	5,157.19
<b>Netherlands</b>	-4.28	6.05	-0.27	-0.98	0.52	168.33
<b>Portugal</b>	-9.21	-0.09	-1.75	-5.67	-16.72	-3,706.06
<b>Spain</b>	-3.35	2.21	12.46	-4.46	6.85	1,538.55

Notes: This table summarizes the cumulative doppelganger gaps for each euro member country and presents the channels driving the impact of the accession by decomposing GDP into its components. The doppelganger gap represents the percentage GDP gain or loss in 2007 from adopting the common currency, i.e. for country  $c$  we define *percent doppelganger gap* $_{2007,c} = (GDP_{2007,c} - GDP_{2007,c}^{dop}) / GDP_{2007,c}^{dop}$ . Then, the table shows the contribution of each GDP component for the GDP gain or loss. Values are constructed in a way to sum up to the doppelganger gap. The decomposition of net exports into exports and imports is presented in Table B.7.

**Table B.7: Net Exports Decomposition**

	Net Exports	Exports	Imports
<b>Austria</b>	-3.98	5.35	9.34
<b>Belgium</b>	-8.24	22.62	30.86
<b>Finland</b>	-4.60	1.63	6.23
<b>France</b>	-3.20	-12.36	-9.17
<b>Germany</b>	0.98	-5.71	-6.69
<b>Greece</b>	-11.62	-5.60	6.02
<b>Ireland</b>	0.23	69.65	69.42
<b>Italy</b>	1.38	-2.75	-4.13
<b>Luxembourg</b>	30.07	153.19	123.12
<b>Netherlands</b>	-0.98	15.38	16.35
<b>Portugal</b>	-5.67	-3.13	2.54
<b>Spain</b>	-4.46	1.64	6.10

Notes: This table presents the summary of the net exports decomposition into exports and imports for each treated country. It tells how much the net exports contributed to the doppelganger output gap in percent.

**Table B.8: Doppelganger GNI Gap**

	AUT	BEL	FIN	FRA	DEU	GRC	IRL	ITA	LUX	NLD	PRT	ESP
<b>GNI Gap</b> (€ per capita)	-4,755	-1,379	1,467	-4,117	-4,838	-	2,965	-4,934	-	-1,821	-3,520	-242

Notes: This table presents the doppelganger gni gap per capita in 2007. This measure is obtained by adjusting the real GNI gap to 2011 Euros as we do in Table 1. We use the conversion rate available from the PWT 9.1 for this year ( $\approx 0.73$ ).